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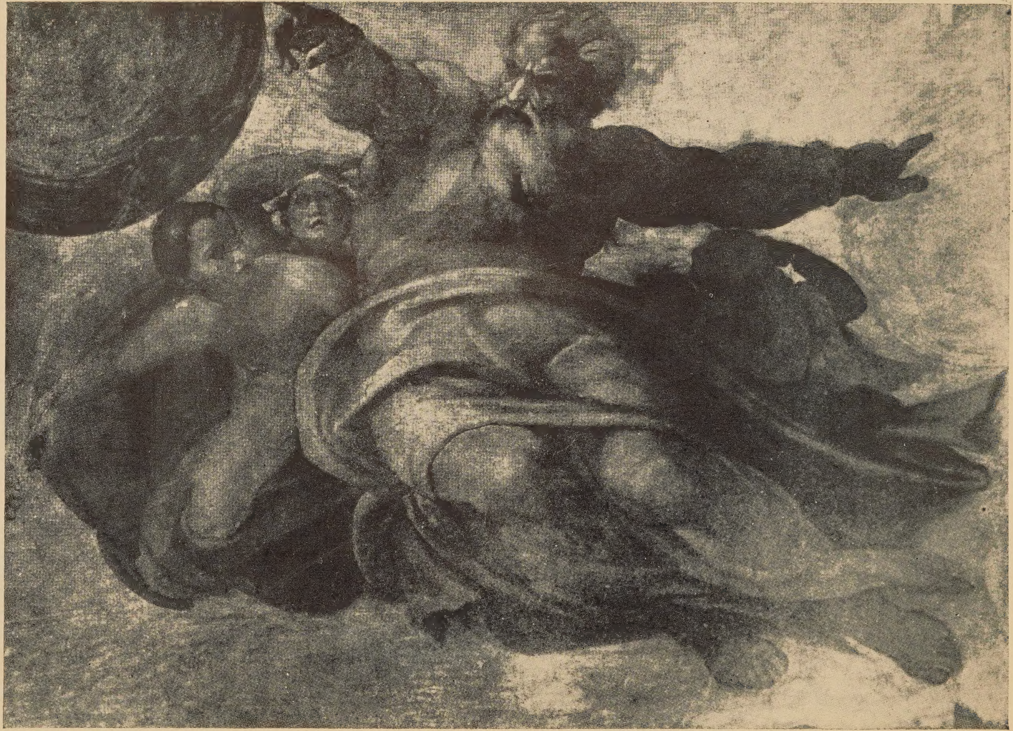

GOD THE FATHER CREATES THE SUN AND MOON.

A portion of one of Michelangelo's Sistine Chapel frescos painted between 1508 and 1512.

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CREATION

A History of Non-Evolutionary Theories

By

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Member of the History of Science Society

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PREFACE

THE present-day controversy over Evolution brings to light a most curious situation. If one is interested in looking into both sides of the question, there is on the one side a vast array of school and college textbooks, encyclopedia articles, and special works that set forth the general content of the theory of evolution and its various special aspects. On the historical side, there are various histories of science, besides such special works as Henry Fairfield Osborn's *From the Greeks to Darwin*. In short, concerning any side of Evolution, there is no point which anybody who can read and write can not cover in a very short while in any decent library.

But, curiously, on the side of Special Creation, there is virtually nothing to correspond to this ample and competent and up-to-date literature of Evolution. Hundreds there are, indeed, of books and pamphlets and sermons and lectures by persons who believe in Special Creation, that attack present-day opinions of the scientific world, though by no means always with strict regard to what those opinions actually are. But, so far as appears, there has been no systematic account of creationist theory that is later than the pre-Darwinian editions of Lyell's *Geology* and Agassiz's

An Essay on Classification of 1859; and there seems never to have been any history of creationist theory that in the least duplicates Osborn's book.

It is this last omission that I have here endeavored to supply—to make, so to say, a *From the Jews to Bryan* out of which an interested reader can get conveniently the general history of creationist ideas as he has long been able to get conveniently the history of evolutionary theory.

As it turns out, speaking always from the standpoint of history, there actually have been no fewer than five theories of creation that are so far incompatible with one another that no two ought to occupy the same mind at the same time. Unless one knows something about them all, and who has held which and when, and which—if any—the Bible teaches, one is hardly in a position to pass intelligently on various disputed matters.

After all is said, we commonly view any idea most understandingly against its background in the past. On the whole, History has been a just and wise judge; and to History, in the present situation, we may well appeal. If the actual course of History turns out on examination to be quite other than is commonly supposed, that is not my fault.

E. T. B.

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CHAPTER I

THE SKIN-SHIFTING OF NATURE

It is indeed hard to realize, in these scientific times, that if any one of us had chanced to be on earth only a little more than a brief two centuries ago, he might well, as part of his routine civic duty, be called to serve on a jury in a witchcraft case. Any one of us, moreover, being drawn for such a jury, might have heard testimony to the effect that the prisoner at the bar—to cite a Virginia case of 1698—after hag-riding the witness's wife, had been seen to escape through the keyhole in the form of a black cat.

Now the extraordinary thing about testimony of this general sort, that was offered in trials all over the western world between 1650 and 1700, is that everybody believed it. Juries, on such evidence, brought in verdicts of guilty, and courts sentenced the convicted to a highly unpleasant death, eight hundred wretched old women in a single year in the bishopric of Würtzburg alone. Even attorneys for the defense, though they might doubt the witness's eyesight or impugn his general veracity, would never dream of questioning the antecedent probability of a human being's changing at will into a cat, or going out through a keyhole. All this, everybody except the witch would take for granted.

In other words, all our modern notion that each living creature has any sort of fixed anatomy, that stays about the same year after year, and can not be altered by any magic into something else, is really a rather new idea in the world. As late as 1895, in an out-of-the-way corner of Ireland, Michiel Cleary, assisted by his neighbors and his wife's father, roasted his wife to death at her own kitchen fire. None of these thoroughly well-meaning people believed for a moment that he was ill-treating Bridget Cleary. They thought they had caught the local witch in Bridget Cleary's form, and they were forcing her to alter back into her own.

Poor Michiel, nevertheless, besides losing his wife, got twenty years penal servitude; and all just because he happened to be living in 1895. If it had been 1695 instead, he probably would not have come to trial at all; and if he had, every one of us who reads this book, being on the jury, would have voted to acquit him; and he would probably have received the thanks of the court. So much did men's opinions alter in two hundred years.

As for *loupe garsons,* the woods of the Middle Ages everywhere were full of them. We best know them as werwolves; but the Latin calls them *versipelles,* that is "skin-shifters"; and all persons up to quite recent times have believed in something of the sort, though in the East the werwolf is a hyena and even in Europe women more commonly alter to cats.

The North German werwolf, in his human phase, put on a belt of wolf's skin, pulling up the buckle to one hole or another, according to the time for which he desired the transformation to last; but he could always, if he wished, pull off the belt with his teeth and turn back again into a man. They were dangerous creatures, these *loupe garsons,* for they devoured men as well as cattle. Yet if a threatened man were armed, and had the presence of mind to load his gun with silver coin out of his pocket or silver button off his coat, he might see the ravening beast change back under his fire into a wounded man. People believed in skin-shifting long after they used gunpowder.

Then there are, of course, the familiar nursery tales, that our own forebears believed not so long ago, as men in other lands believed the stories of the *Thousand and One Nights,* and still earlier men believed the myths of Greece and Rome. We do not happen to opine that seamen ever changed into Circe's pigs, that Daphne became a myrtle, that unfortunate princes have been altered into apes by enchanters who could also transform their own bodies into anything they liked, that little imps take the child's place in the cradle, that swan-maidens beguile the hearts of men. But other people just as clever as we have believed just these things; and the reason why we do not is no merit of ours.

One could go on at almost any length piling up stories of all types of skin-shifting, from the *Thousand and One Nights* with its stock formula, "If thou wast created a beast, retain the form in which thou wast born; but if thou wast born a man, then resume the form which Allah gave thee," down to the latest traveler's tale of the superstitions of Russia or Ireland. Still, one never quite knows just how much of these traditional yarns people really believed, and how much they only half believed for the sake of cold chills down their backs. Therefore, one builds up a truer picture of pre-scientific opinion as to the continuity of nature by sticking to serious discussion by scholarly theologians and to actual court cases.

Certain it is, judged by this class of evidence, that all through the Middle Ages learned ecclesiastics and acute jurists—and still more, naturally, unlettered men—held opinions which in our day would be quite incompatible with sanity.

Augustine, for example, to keep roughly to the historical order, relates quite soberly that in his day there were innkeepers who turned their guests into animals by putting certain drugs in their cheese. But Augustine, in addition to being an extraordinarily gifted and acute person, was too near to the skeptical atmosphere of pre-Christian times to have anything like the all-embracing credulity of his successors in the bishopric. The Salic laws of the fifth century enact that an enchanter who transforms himself into a wild beast and kills and devours a man shall, upon proper conviction in court, be fined two hundred sous.

Or to take a long jump both in space and time, toward the end of the sixteenth century, that is to say, after Copernicus was dead and after Galileo had begun his scientific career, a French judge, having himself sentenced some hundreds for lycanthropy, wrote a book about the crime and drew up a code which permitted ordinary witches to be strangled before they were burned, but burned werwolves alive. That single judge in the course of his professional duties, burned some five hundred lycanthropes. About 1700, in Scotland, four ministers signed a certificate attesting the fact that a man attacked by a cat succeeded in cutting off one of its legs, which immediately turned into that of an old woman.

But if men can change themselves into wolves at will and women alter into cats, and if enchanters can transform any living creature into anything else, what may not devils and angels do?

Michael Psellus of Bysantium, writing in the eleventh century, lays it down both as a general principle and as a rather obvious fact that all demons have bodies of a refined, subtile, and essentially cloud-like sort, that can pass through any orifice and assume any shape. Aquinas, two centuries later, carries still further the same idea. "*Omnes angeli,*" he asserts in addition, "*bone et mali, ex vertute naturali, habent potestatem transmutandi corpora nostra.*"

All this had its inconvenient side. The judge on the bench, especially at a trial for heresy or witchcraft, might really be a devil in disguise intent on frustrating justice by confusing the testimony of the prosecution's witnesses. Medieval books contain many a legend of demons who took on the similitude of prominent churchmen, got themselves discovered in scandalous situations, and but for the intervention of notable miracles would have ruined Christian reputations.

Luther, in particular, for all his abounding common sense in most fields, was half crazy over devils, seeing them everywhere, and notoriously flinging his inkstand at one. He maintained that in many cases of alleged suicide, what really happened was that a devil has taken on a convenient form and strangled the victim. He also investigated at first hand a case where the devil had fathered a child; and though Luther was a humane man, as men went in his day, and uncommonly fond of children, he felt constrained to advise that the child's relatives forthwith drown the devil's brat.

One need not multiply evidence. The point is that up to about the time of Montaigne's skeptical *Essays* and Voltaire's scornful ridicule, most courts took at its face value testimony concerning the skin-shifting of men into wolves, women into cats, and angels and devils into anything; while such individual judges as were so far infected with the growing skepticism of the seventeenth and eighteenth centuries as to throw out this sort of evidence, forthwith had the clergy in their hair. The last judicial execution for witchcraft is thought to have been in Switzerland in 1782. The last law in western Europe was an Irish statute, repealed in 1821. Persons who accept witchcraft as a contemporary phenomenon, always believe also in skin-shifting in some form.

Inanimate nature, in the Middle Ages, "skin-shifted" freely. There were the alchemists, trying to transmute base metal into gold, and actually getting various alloys and enamels that had some of the attributes of the royal metal, to keep alive the reasonable hope of obtaining the rest. In the seventeenth

Christian century, the learned Jesuit father, Athanasius Kircher, in his once famous *De Arca Noae,* argues that the Great Flood was produced by a miraculous alteration of the atmosphere into water, and came to an end when the water was changed back again into air; and his idea was quite favorably received by rationalizing clergymen, both Catholic and Protestant, who sought to adjust the Bible narrative to their contemporary science.

One gets, however, a quite wrong idea of alchemy if he thinks of it only as fraud. Fraud it did indeed become toward the last, in the seventeenth and eighteenth centuries, pure rascality practised by notorious charlatans for the money there was in it. But in ancient Egypt and in pre-Christian Rome, what was afterwards to become alchemy was a perfectly straightforward and not unsuccessful experimental study of bronzes and enamels.

We must not forget that our scientific chemistry is only a little more than a century old. Up to about Dalton's time, that is to say well into the nineteenth century, nobody had any sharp idea of what we now call atoms, chemical substance, and the conservation of matter. For us, gold, for example, is something with a specific gravity of 19.3 and a very definite and characteristic behavior toward various acids and other chemical bodies. We recognize gold chlorid as both gold and chlorin, although it does not look in the least like either.

But for the ancient world, up to eighteen hundred, whatever looked like gold, was gold. It might be what we now call a glass or an enamel or a bronze, without a single one of the chemical properties of gold; but if it was yellow, and fairly heavy, and did not too quickly and too obviously tarnish in the air, then it was the king of metals. The ancient world recognized various sorts of gold where we see no gold at all. For it, quite reasonably, a gold-colored alloy was gold.

Egypt and Rome, then, with Christian Europe from the eighth century into the eighteenth, did much sound and careful work on gold-appearing compounds of various kinds, all of which, logically enough, they regarded as only different varieties of true gold. By the fifteenth century, in Europe, general learned opinion had it that as plants germinate from seeds, so there is all the while also naturally in the ground a development of metallic "seed," in such wise that a mine, once exhausted, may renew itself. In the same way, the baser metals in series, iron, lead, silver, and the rest, are perfecting themselves and becoming more and aureate, very much as fruit ripens from unattractive beginnings to full maturity. The alchemist with his philosopher's stone aimed only to expedite this natural process much as the farmer cultivates his crops and improves the wild fruits of the earth.

That all this could actually be done was the universal and unquestioned belief of Europe for a thousand years. Albertus Magnus and Roger Bacon both experimented in the field. In 1404, the English Parliament passed an act that made it felony to manufacture either gold or silver. Von Helmont, who coined the word "gas," and who died in 1644, was an alchemist; and so was Paracelsus who helped lay the foundations of present-day medicine. Unfortunately, there were also not a few alleged transmuters of metals who were seized by ambitious but impecunious statesmen, thrown into dungeons, and set to making gold under persuasion of a sort only too familiar during pre-scientific times.

In short, it was not really until after the close of the eighteenth century, some years therefore after the adoption of the American Constitution, that the idea finally got inside the human skull that gold stays gold and lead stays lead, that the leopard can not change his spots, and his skin and bones along with them, or that angels and devils, together with enchanters and witches of all sorts, can not alter their own bodies as they like or transform at will the bodies of other men and animals. Men did, indeed, believe in "creation." But any creature, once created, might alter into almost anything else over night. Only with these facts in mind, can any one in the least understand what ancient worthies meant when they said "create." Hardly yet, indeed, is nature always thought of as "uniform."

The Bible, always our convenient storehouse of primitive notions, has some uncommonly good examples of this ancient and universal transformationism. Thus, for example, in the Revised Version, runs a familiar portion of Exodus 7:

"And Moses and Aaron went in unto Pharaoh, and they did so, as the Lord had commanded: and Aaron cast down his rod before Pharaoh and before his servants, and it became a serpent. Then Pharaoh also called for the wise men and the sorcerers and they also, the magicians of Egypt, did in like manner with their enchantments. For they cast down every man his rod, and they became serpents: but Aaron's rod swallowed up their rods."

One must not be unsympathetic toward people who reasoned just as correctly as we do, but knew fewer facts. On the face of things, if one has not looked into the matter, a serpent should quite as easily arise by mutation of a long, brown, dry stick as by evolution from a small, round, wet, white egg. We happen to know—though rarely indeed at first hand—

that snakes do hatch from eggs. We chance not to have read anywhere in any book of recent date, that enchanters' rods alter into snakes. But really, on the face of things, one origin is no more remarkable than the other; we are merely more used to the idea. Moreover, a few of us know what is inside the rod and inside the snake; and we have seen something of the limits of anatomical and atomic change. But people who think that magic will alter rods into serpents are not stupid; they are only ignorant.

Exodus 7 continues:

"And the Lord said unto Moses, thou shalt stand by the river's brink to meet him; and the rod which was turned into a serpent shalt thou take in thine hand. And thou shalt say unto him . . . behold, I will smite the rod that is in mine hand upon the waters which are in the river, and they shall be turned into blood. . . .

"And Moses and Aaron did so . . . and all the waters that were in the river were turned into blood . . . and the Egyptians could not drink the water from the river; and the blood was throughout all the land of Egypt. And the magicians of Egypt did in like manner with their enchantments. . . .

"And the Lord said unto Moses, Say unto Aaron, Stretch out thy rod and smite the dust of the earth, that it may become lice. . . . And Aaron stretched out his hand with his rod, and smote the dust of the earth, . . . and all the dust of the earth became lice throughout all the land of Egypt."

Here again is that same primitive transformationism, that all men once assumed and that the world has even now only just outgrown. Not only do dry sticks become snakes; in addition, water changes to blood, and dust alters into lice—or whatever creature one prefers to understand by an obscure word. Nevertheless, in general, the metamorphosis is not too violent. Each skin-shift is into something that looks a good deal like the original object.

Even here, too, there are curious limitations. The Devil, in our own Christian mythology, can shift skin to become a man of the world, or a holy friar, or a lady fair—but he can not, it is maintained, alter his feet. If then, one is clever enough to watch for the cloven hoof, and quick enough with the sign of the cross, the Old 'Un will have to shift back to his true form, and one's soul is saved. In much the same fashion, the troll impersonating a lady fair, remains hollow behind; whoso gets sight of her back at once sees through the sham. Altogether, then, pre-scientific imagination, for alterations of size and shape, had by no means unlimited flight.

The second plague of Egypt, to follow the conventional order in a mixed-up narrative, introduces a different though nearly universal idea. In Exodus 8 we read:

"And the Lord said unto Moses, Say unto Aaron, Stretch forth thy hand with thy rod over the rivers, over the streams, and over the pools, and cause frogs to come up over the land of Egypt. And Aaron stretched out his hand over the waters of Egypt; and the frogs came up and covered the land of Egypt. And the Magicians did in like manner with their enchantments and brought up frogs upon the land of Egypt."

Here, it is to be observed, there is no direct metamorphosis of anything else into frogs. Aaron's rod, which when it was a serpent had swallowed up the enchanters' serpent-rods—if one may interpret this ancient and obscure story in the light of what we know in more detail of other and later stories like it—had thereby acquired special *mana*. Thus Aaron—with also the enchanters, whose rods likewise have *mana*—is able to cause the waters to bring forth abundantly the moving creature that hath life, in this special case, frogs. The idea, apparently, in the back of the writer's mind is that the waters of Egypt, of themselves, in ordinary circumstances, produce various "creeping things." All that the special *mana* does is to increase their number. Probably, too, in the same way, the dust of Egypt is regularly, all the while, changed to lice. The *mana* only speeds up the process, as later the philosopher's stone only speeded up the natural change of baser metals, through the series, into gold. In general, ancient Egyptian opinion held to the regular spontaneous generation of both frogs and mice.

All this, in short, illustrates that primordial, universal belief of all the ancient world in "spontaneous generation." Matter, of almost any sort, simply "brings forth" plant life and animal. It is not quite that the earth alters to the plant or animal; and yet that idea is never much out of the picture. Sometimes, indeed, a definite substance transmutes—dust to lice, water to blood. More often the living creature merely appears, "brought forth" vaguely by "the earth."

Here, then, is the primitive evolutionism—a known and visible animal need not have had a forebear like itself, nor leave descendants after it. The larger animals, certainly always the domestic animals and man, do indeed have parents and offspring. Presumably, therefore, the line runs back to the creation. But nowhere in the ancient world, and nowhere in the modern world up to the seventeenth century, do men think of all animals, still less of all plants, as having any ancestral tree with its roots in the beginning. Most creatures—all little, unimportant things—have been spontaneously generated. The earth or the water or some other substance has brought them forth, it may be this very day. They have no ancestry. They will die and leave no descendants. Nature, to-morrow, will generate more like them. The whole idea of a creation at the beginning, once for all, that started lines of descent that have persisted till now, is a strictly modern theory. No ancient worthy, no Biblical contributor, has ever heard of it.

The ancient world, moreover, by no means always supposed that even the races of men need all go back to the beginning, or that all mankind has a single origin. There are, of course, the Myrmidons, transformed from ants, the warriors of Cadmus grown from dragon's teeth long after the world was full of other men. Deucalion and Pyrrha, after the flood has destroyed mankind, renew our species from the stones of the earth; the earth itself, apparently, without assistance, taking care of the lower animals, which also perished. The Egyptians, for example, held that the same fertile mud which the Nile brought them every year for their crops, had in an earlier day brought themselves also forth. In general, the ancient world, while it often thought of men as shaped by the hand of deity out of the dust of the earth, was rather more given to the view that the races of men—or at least, for each nation, other peoples than one's own—are autochthonous, issuing spontaneously out of the same earth that afterwards feeds them.

Herein, probably, lies the secret of that long discussed mystery, dear ever to the heart of the bishop-baiter: Where did Cain get his wife? Cain, in Genesis 4, has just made away with his brother Abel, and as the story runs, there are only three *created* human beings in the world:

"And Cain said unto the Lord, My punishment is greater than I can bear. . . . I shall be a fugitive and a wanderer in the earth; and it shall come to pass, that whosoever findeth me shall slay me. And the Lord said unto him, Therefore whosoever slayeth Cain, vengeance shall be taken on him sevenfold [i. e., apparently, the slayer and six kinsmen shall suffer death]. And the Lord appointed a sign for Cain, lest any finding him should smite him. . . .

"And Cain knew his wife; [of whose origin nothing is told] and she conceived, and bare Enoch: and he [i. e. Cain] builded a city."

One can not suppose for a moment, that in a document so frequently and so competently edited and revised almost down to the close of the Old Testament canon as was the Hexateuch, Cain's wife and Cain's fear of vengeance and the people who were to live in Cain's new city are in any wise oversights. The narrative that has reached us has gone through too many and too skilful hands to contain blunders.

Rather is it that at least the later editors of Genesis assume a reader already familiar with, and sharing, the wide-spread belief of the ancient world in autochthons, true indigenes of the lands they inhabit, sprung from the soil by natural process, uncreated by divinity, "without father, without mother" like Melchizedek, king of Salem. Cain, apparently, married one of these and feared the rest.

In brief, then, pre-scientific man has, in general, conceived two quite diverse origins for the plants and animals and human beings that he sees around him.

Some men, and with them the larger and more interesting of the lower animals, were thought of in a vague way, as "created" in the beginning, either as literally shaped out of wet clay by the veritable fingers of a tribal god, or on a higher, more philosophical level, as generated by the Word or Breath or Wisdom of the Almighty. In either case, the process is not commonly thought to recur; and the present-day animals and men are taken to be the descendants of these first created, or of some other ancient set.

On the other hand, most vegetation outside the planted crops, some of the larger animals, and often races of men other than one's own, with virtually always all "creeping things," are thought to arise by spontaneous generation out of earth and water and various other substances, by "natural" process with which no god is concerned. All these little, swarming creatures without conspicuous legs, from lice to lizards, which the Bible lumps together as "everything that creepeth upon the ground," have, in general, no ancestors, and they gender no offspring. They simply come and go like the dewdrops on the grass, to-day's set in no wise related to to-morrow's. Therefore, "among the creeping things that creep upon the ground; the weasel, and the mouse, and the great lizard after its kind" there need be no precise duplication of form and color from day to day. The earth brings them forth as it will, more or less alike, but without "inheritance" of any quality.

Clearly, then, so long as the learned and critical portion of mankind continued to accept without question any part of this old folk belief in metamorphism, skin-shifting, spontaneous generation, and the like, there never could arise any problem of Creation *vs.* Evolution. For whenever the ancient world thought of the Almighty or its special tribal god as "creating" any sort of being "out of nothing," it also along with this thought of the created being as changing afterward into something else; and that change, in a broad sense, is an "evolution." Whenever the ancient world thought of men evolving out of Nile mud, or of the waters of Egypt becoming gore, once more, along with this, it also thought of the Almighty or its tribal god as commanding the earth to bring forth abundantly or watching over whatever process occurred while it went on. But this, also in a broad way, is "creation."

Later, we shall have occasion to analyze accurately our present-day meanings of the two contrasted words. But for the present, and while we are still dealing with primitive ideas, or in general until we have carried our history down into the eighteenth century, when our modern concepts of evolution and creation first took on their present form, we shall interpret most sympathetically the ideas of the ancient giants in the earth, if, in so far as we are able, we empty our minds of all sophisticated and precise distinctions, and think of all origins as by way of ill-defined "creative evolution" or evolutionary creation. Each ancient worthy, struggling with origins, puts his special stress on some aspect of the world. One philosopher will dwell more on the finger of God. Another will look to spontaneous operations of nature. But neither will doubt the other's view. All men in the ancient world, and all men down through the Middle Ages, believed in some sort of creation. But they all, along with this, believed also in some kind of evolution. Men did not, until lately, distinguish the two. The Bible, as we shall discover, teaches both, in the sense that in addition to an original "creation" there goes on all the while a transformation of various created beings into something else—dust into lice, rods into serpents, and the earth, vaguely, into creeping things and foreigners.

In other words, all creation theories up to within a couple of centuries have to be viewed against a background of transformationism. What we now call, not altogether happily, "the uniformity of nature" is a strictly modern idea.

CHAPTER II

THE DIVINE ARTIFICER

ONE does not get very far with understanding history unless he keeps always in mind the difference between an ancient book and a modern one.

The present work, for example, is written out in full on the typewriter and then carefully revised by the author. Next it passes through the hands of the publisher's "copy man," and is again carefully reviewed. It is then set in "galleys" and a proof-reader goes over it for mistakes of printer and author alike. In page proof it gets still another revision, and when it is presumably about as right as it can be made, it is cast into the plates from which it is to be printed. After that, to change a comma to a semicolon will cost the royalties on several copies. In addition, there is a copyright law to prevent undue borrowing, while anybody who uses so much as a single sentence of its text puts the borrowing in quotation marks.

Not so was it before the invention of printing. All books were written out by hand anyway, and it was always just as easy to make changes as to re-copy the old text. Nobody ever quoted. If an author wanted to use any old material, he simply copied off what he liked, left out whatever he did not like, altered over what he preferred some other way. Each new book was made by stringing together parts of as many old ones as the author cared to use, with the addition of whatever the writer had picked up for himself, variegated with all the misinterpretations and most of the clerical errors of all the authors and copyists that had gone before. Nobody had any conscience about borrowing; nobody had any conscience about making all the alterations, omissions, and interpolations he liked in the borrowed material, and then passing off the result as original. We commonly dwell on the copyists' errors in old manuscripts. We too often ignore how much of most old manuscripts is what we should now call deliberate forgery.

All really ancient works, therefore, like the Gathas and the Hexateuch and the Coming forth by Day, are essentially accreations. They start with a nucleus and grow by slow additions, as one scribe after another recopies and re-edits the text. Commonly, the accreation round one nucleus fuses later with the accreation round another; these in their turn fuse with a third and a fourth and a fifth, until it becomes one of the most difficult of critical problems to disentangle the several elements. But disentangled they must be, else they can not be used as data for scientific history.

The Hexateuch, in particular, which is for most of us the one important source of information concerning the ancient world, has had a very long and a very complicated history. There are to begin with bits of enormously ancient lyrics like the Lament of Lamech (Genesis 4:23) and the Song of Deborah and Barak (Judges 5) together with longer portions of old sagas such as the *Book of Jashar* and the *Book of the Wars of the Lord*, that are quoted in Numbers, Joshua, and Second Samuel. Speaking broadly, the Book of Joshua is about the oldest continuous narrative that we still have in anything like its ancient form.

Two of the main nuclei of the Hexateuch are the so-called "Elohim narrative" and the generally parallel "Jahvistic" account, only the latter of which, however, contributes a creation story. The great mass of the "Law" is, however, the much later "Priestly" compilation, from which comes substantially the whole of the books of Leviticus and Numbers, with much of Deuteronomy and portions of Genesis and Exodus.

One greatly errs, therefore, in reading the creation narratives of Genesis and the stories of the great deluge, by running together the "Jahvistic" and the "Priestly" source of either. The two elements are of quite different ages. They disagree on matters of fact. Their entire background and "world-view" are unlike. Therefore, to jump back and forth from one to the other is to make impossible any real understanding of either.

"J," as the formulas of scholarship call both the ancient Jahvist author and his text, is, of course, much the older, of *circa* 850 B. C., and thus some three centuries earlier than the Exile and the renewed contact with Mesopotamia. Its geography, therefore, is that of Palestine—of southern Palestine in particular—and it presupposes everywhere a hill country, where the rivers are small and fed directly by the rains, and where the people, who do not eat fish, know little of the ocean and the ways of sailor men. In J, therefore, the dry land comes first in creation, there is no mention of the Great Deep, and the "rain upon the earth" alone provides the water for the Flood.

J, as conventionally printed, begins in the middle of the fourth verse of Genesis 2. The text here quoted is substantially that of our Revised Version, occasionally altered from familiar to more literal readings:

"In the day that Jahveh made earth and heaven, no plant of the field was yet on the earth, and no herb of the field had yet sprung up; for Jahveh had not caused it to rain upon the earth, and there was not a man to till the ground; but there went up a thick cloud [originally, it is most probable, a fountain of the Great Deep; but J has no idea of any Great Deep] from the earth and watered the whole face of the ground. And Jahveh formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul."

All our versions unite to obscure the meaning of this simple-minded passage. The Hebrew verb which we, for edification, render "formed" really means "to mold with the fingers like wet clay," as the Septuagint frankly renders it, using *plassein,* whence our "plastic." We really ought, therefore, to say: Jahveh "pottered" man out of clay and blew the wind into his nose. But, of course, that would hardly do.

Parenthetically, at this point, we may well turn aside to consider a matter which is to come up again, the Great Deep and its "fountains."

The Hebrews, it is well known, having no science of their own, borrowed mostly from Babylon, taking their geography and astronomy virtually unchanged, but altering the accompanying theology very much for the better. Even down into New Testament times in Israel, this ancient Mesopotamian cosmology, in spite of Greek influence, remained virtually unaffected.

The Babylonian earth is, of course, flat, like most primitive worlds. Unlike most, however, the dry land has water under it—the Great Deep or waters of the Abyss, which appear in the creation story of Genesis 1 and in various passages of the Psalms and other por-

Courtesy *Harvard College Library*

Creation of Adam. From the *Nuremberg Chronicle.*

The *Nuremberg Chronicle* is a history of the world from the creation (B.C. 5199, following the Septuagint) to Anno Mundi 6691 (Anno Christi 1492) the account stopping just too soon to include the discovery of America. The volume, printed in 1493, is a large folio containing about two thousand illustrations, among them the universe as it was at the end of each day of the creation. This picture is from the folio *''de opere sexte diei.''*

tions of the Bible. But whether the earth actually floats on water and whether the Great Abyss is below or above Sheol is by no means clear, and all these opinions have had scholarly support. In any case, however, there is no doubt that a solid sky supports "the waters that are above the firmament," and that when "the windows of heaven are opened" these upper waters fall through the holes as rain upon the earth.

The "waters that are under the earth," which form the Great Deep, connect with the ponds and rivers by way of underground channels, "the Fountains of the Great Deep," so that there is a circulation of sea water, beneath the earth, up to the surface by way of the springs and other fountains, and back to the sea again. Only on some such theory could the dwellers in Mesopotamia account for the water in their two great rivers for which their own ten inches of rain annually is obviously quite insufficient. The Babylonians, living almost in the desert, seem to have known nothing of the heavy rainfall in the highlands of Asia Minor which really supplied the Tigris-Euphrates flood-plain. Here is one more case where the ancient world reasoned ingeniously but from insufficient knowledge of the facts.

As not uncommonly happens, this idea of an abyss of waters underlying the land everywhere, with fountains connecting with the springs and streams, persisted as a theological dogma, retained on the authority of the Bible, long after the course of empire had shifted westward into a rainy climate. Albertus Magnus who died in 1280 held the opinion, and so did St. Thomas Aquinas who was his contemporary. The notion persisted more obscurely long after their time. In fact, it was not until unto the nineteenth century that the progress of geography finally disposed of the mystery of the Nile.

In other words, the Great Deep with its fountains, though topographically a little obscure, is a very essential part of the whole Babylonian-Biblical earth. The origin of the Great Deep, the dividing of "the waters from the waters," and the supporting of the "upper waters" by a solid "firmament" are all essential parts of the creation narrative both in its Babylonian and in its Hebrew form. In addition, the story of the great flood in both turns not a little on the opening of "the windows of heaven," when "the fountains of the Great Deep were broken up." To understand how the world was thought to be created and thought afterwards to have been in part destroyed, one must also understand what sort of a world it was thought by Israel and Babylon to be.

To return now to our creation narrative as it appears in J, Jahveh, we are told, next planted Paradise, "and out of the ground made to grow" various trees, and "took the man, and put him into the garden of Eden to dress it and to keep it."

"And Jahveh said, it is not good that the man should be alone; I will make a help meet for him. And out of the ground Jahveh 'pottered' every beast of the field and every bird of the air; and brought them unto the man to see what he would call them; and whatsoever the man called every living creature, that was the name thereof; but for man there was not found a help meet for him.

"And Jahveh made a deep sleep to fall upon the man, and he slept; he took one of his sides, and closed up the place with flesh. And Jahveh 'pottered' the side which he had taken from the man into a woman, and he led her to the man."

Our conventional renderings, rather spoil the point of this story of Eve's creation. We follow the Vulgate, which in turn copies the Septuagint. But the Hebrew reads, not "rib" but "side." Jahveh really cut his man a good deal, or quite, in halves; and taking the spare half, he built it up with wet clay into a complete woman. Otherwise, the man, while he might properly say "this is now bone of my bone" could hardly add "and flesh of my flesh," if his bride were built up around only a single rib. Moreover, there are wide-spread accounts all through the Mediterranean district of an original androgyn, cut in halves to make the first pair of mortals. The Jahvist account probably reflects this idea.

From this point J continues with the familiar story of the Fall through Genesis 3 and 4, P taking up the tale at Chapter 5.

Two points stand out clearly from this narrative. To begin with, J gives no hint anywhere of any "creation" out of nothing. There is the "dust of the earth," and Jahveh "potters" it, first into Adam, then into the animals, and then into the missing parts of Eve. After the fall, is Adam set "to till the ground from whence he was taken." "In the sweat of thy face shalt thou eat bread, till thou return unto the ground; for out of it wast thou taken; for dust thou art, and unto dust shalt thou return." Jahveh is always the artificer; never, strictly, a creator.

Moreover, the number of creatures modeled out of the wet clay is strictly limited. The Jahvist does not bother with any swarm of "creeping things." His concern is only with the "cattle," that is to say, with his two or three domesticated quadrupeds, with "the beasts of the field," which are the larger wild animals, and with the birds. The plants take care of themselves. If there is enough rain, up they come. They are neither created nor made.

J's mental picture, then, includes, at most, only a score or two of "species" which Jahveh makes. Adam names them all with the few score terms of the Hebrew tongue, carrying their names, apparently, in his memory. Certainly nothing could be further from J's intent than to picture Adam toiling eight hours a day, assigning one name a minute, while Eve noted it down, and taking ten years to cover the two million animal species of present-day science. Creationism, in its current form, is certainly *not* taught in the J portion of Genesis 2.

Nor is the flood story of J any more compatible with modern Creationism. Noah, in Genesis 7, gets seven days' notice of the Deluge; and prepares a chest or box, not a ship, of which the hill man has little idea.

"And Noah came, and his sons, and his wife, and his sons' wives with him, into the ark before the waters of the deluge," under instruction which in the fuller text of the Septuagint, of which parts are lost from our later Hebrew text, reads: "Of all clean cattle thou shalt take with thee seven pairs, the male and his female, and of cattle which is not clean one pair, the male and his female. Also of the fowls of the air which are clean seven pairs, the male and his female, and of fowls which are not clean one pair, the male and his female, in order to preserve their living seed upon the face of all the earth. . . . And every living being which was upon the face of the ground was destroyed, [J's editor here interpolates: from man even to the cattle, the creeping things and the fowls of the air, and they were exterminated from off the earth] and there remained only Noah and those who were with him in the ark."

All this is quite in line with J's creation story. The creeping things are not taken into the ark. They perish; but they can "just grow" again, like the plants, as they did at the beginning. The numbers, as before, are small. No such problem confronts J as the present-day literalist encounters with his eighty great cats, and his thousand pairs of "clean" ungulates, and his twenty thousand birds. J gives no dimensions for his "box." He may well have visualized a fair-sized house, with fifty or a hundred birds and quadrupeds. Evidently J does not realize that there are some three hundred and sixty thousand insect species on the earth.

Last of all, though the passage is often assigned to one or other of J's editors, "Noah built an altar to Jahveh, and he took of all clean cattle, and of all clean fowl, and he offered a sacrifice upon the altar." Evidently again, J does not think of "all clean cattle and of all clean fowl" as involving any great numbers.

It is common knowledge nowadays that the J portion of Genesis, and parts of P as well, follow or closely parallel much older Chaldean, Babylonian, and Assyrian documents, some of which go back to stories that are of dates as early as 2500 B. C. In particular, there is the "Caldean Genesis" which George Smith unearthed and translated in the 1870's.

These Mesopotamian sources are, in general, fuller and more detailed stories than the Bible renderings; and they tend, being nearer the originals, to retain clear mental pictures where Genesis has only a traditional form of words. Thus, for example, the Caldean ark is a real ship with sails, navigated by seamen, its cargo carried aboard by 3600 porters and stowed shipshape; and the raven, which in the Biblical account merely fails to return, is represented in the tablets as resting itself on the floating corpses and gorging itself on the carrion.

> "I sent forth a Raven and it left.
> The Raven went and the dead bodies which were on the water it saw.
> It did eat—it floated and was carried away—it returned not."

Nevertheless, the whole background and color of the Mesopotamian narratives is identical with that of the Biblical J. Other gods than Jahveh are the potter—but they all shape the first man out of the dust of the earth. Thus, the Caldean Noah, viewing the desolation as the Flood began to abate:

> "I watched the sea making a tossing
> And the whole of mankind had gone back into clay."

while the great goddess Isthar "cried out like a bearing mother,"

> "Behold how men have returned to clay."

Unfortunately, the creation story is lost out of this set of tablets. But another fragment says of some divinity, apparently Ea, the father of Marduk, "that his commandment be firm and never be forgotten in the mouth of the race of men, that his two hands have formed."

Here, in short, alike in clay tablets of Assurbanipal and in our own Christian Bibles just off the press, is the wide-spread, almost universal, story of the divine artificer, who does not "create" anything, but only molds the preëxistent dust or clay with his hands and shapes it into men and animals, mixing it with the blood of other gods or blowing upon it with his breath, to endow the image with a soul. The idea is as old as history, and it crops up everywhere—Egyptian figures show the Divine Potter actually at work. But we know it, for the most part, only in the J element of Genesis.

The early church explained the idea away, being fresh from Greek philosophy and Greek science, and not liking anything so primitive. But the medieval mind, always essentially childish, found the picturesquely simple tales of J quite to its liking. The Garden of Eden, Eve out of the rib, the talking serpent, the slaying of Abel, the Tower of Babel, Abraham, Isaac, and Jacob, Esau and Rebekah, Joseph and his brethren, and the rest, which are all from **J** or his editor, or from the related "**E**," are still the delight of the modern nursery as they were once the delight of medieval art. Therefore, the theologian of the Dark Ages took to these stories and their world-view as something quite after his own kind, and read back their underlying ideas into the far more philosophical, scientific, and "modern" narratives of the Priestly element. In particular, **J** retains the ancient tale of the Fall of Man, to become the corner stone of all Christian dogma from Augustine down.

CHAPTER III

THE CREATIVE WORD

The Priestly Narrative, in most respects, is quite opposite to the Jahvist. For one thing, it is late, *circa* 500 B. C. in its general substance, with re-writings down to a century or so later.

But 500 B. C., and still more 400, are approaching modern times. The Jews came back from Babylon in 536, and Ezra and Nehemiah ruled Jerusalem a century later still. Most of the great prophets of Israel—Amos and Hosea, Micha, Jeremiah, and both Isaiahs—are earlier than the Priestly Narrative. So are many of the Psalms. Even Job, that like the *Rubáiyát* of Omar Khayyam is every man's contemporary, is, for most of its text, not far from P's time.

Elsewhere in the world, in the fifth century B. C., Persian civilization had already passed its cusp and was following a descending curve. Marathon was in 490. Pericles and Æschylus and Sophocles and Pindar and Sappho are of Priestly age. Socrates died before 400, and Aristotle was born in 384. Immediately after Aristotle began the great period of Greek Science.

Naturally, therefore, the Priestly element of the Hexateuch, unlike the Jahvist, is not primitive. To be sure, **P**, with the reverence for the past of all priests, does copy down the Mesopotamian tradition—the dimensions of the ark, the genealogies of the patriarchs, and many an ancient fragment besides. But **P** himself, in his own world-view, is Greekish and modern.

He tells the flood story on much the same lines as **J**, following closely the Babylonian accounts. But his contact with Babylon is fresh; and he tells his tale as one who has seen the Mesopotamian delta, and the Persian Gulf, which the Mesopotamians took to be a portion of the Great Deep. For him, therefore, not only are the windows of heaven opened, "on the same day were all the fountains of the Great Deep broken up." **P**, moreover, newly touching Babylonian science, is much more of a naturalist than is **J**. He includes everywhere the creeping things along with the cattle and the birds and the wild beasts. Possibly by way of making room for these, he puts in the ark only two of each sort of "clean" creature, instead of **J**'s fourteen.

P's six days of creation are Babylonian, and so is his general order of creation, plants first, then water creatures, then land animals, and last men. He makes the birds come from the water along with the fishes; and, unlike **J**, makes the waters earlier than the land.

But **P**, though he follows tradition slavishly for all detail, cuts loose completely from the past for all his underlying ideas. P knows nothing of any tribal god pottering with wet mud. "And God said, Let there be light; and there was light." P marks the end of the world as an artifact, the beginning of the world as a creation.

The three or four hundred years that separate P from J seems but a short while in the long stretch of history, yet things do happen even in less time. Only one hundred years before the beginning of the present century, Archbishop Usher's chronology was still part of the inspired word, to be questioned only at one's peril. Two hundred years before, accusation of witchcraft was a standard risk of old age. Three hundred years before, they burned Giordano Bruno at the stake for saying that the earth goes round the sun. Four little centuries before the French Revolution, America had not been discovered, men still fought in armor, Doctor Martin Luther was not born, there were no printed books, and half the learned men of Europe thought the earth is flat. History has sometimes stood still for a thousand years. It sometimes has traveled far in a hundred.

Something of the same profound revolution in opinion which marked, let us say, the twelfth and the seventeenth Christian centuries in western Europe, occurred in western Asia about the sixth century B. C.

About then came the prophetic movement in Israel, that really made the best of all our own present-day religions. Of that time are also the two great Indian heresies, Buddhism and Jainism, with Zarathrustra and Confucius not far off. That was another time when the world moved fast; P has as little in common with J as have the long-forgotten church men who contradicted Galileo with Dean Inge and Dr. Kirsopp Lake.

Much is often made of the fact that P uses *Tehom* as his name for the Great Deep; *Tehom* being only the Babylonian *Tiamat* or *Tavthê,* of the first generation of the Babylonian gods, the primitive woman whose body cut in halves forms earth and sky, great-grandmother to the maker of men, and goddess of chaos and primeval night. The tablets call her "the bearing mother of heaven and earth," and the sculptures show her as a monster contending against Marduk, the "Lord of Light," who for his chief weapon employs "the winds which he had created."

All this does, indeed, sound a good deal like Genesis 1. "In the beginning God created the heavens and the earth. And the earth was a desert and an empty chaos; and darkness was upon the face of Tehom, and the wind of God was rushing upon the face of the waters."

Much has been made, also, of the part which the immemorial magic of names and words plays in the Mesopotamian form of the creation stories, where whatever is un-named does not really exist. So we have in **J** the animals brought to Adam "to see what he would call them"; and in **P**, throughout, "And God said," "and God said," "and God said."

Yet it by no means follows that because **P** repeats primitive verbal forms, **P** means to express primitive ideas. **P** is by no means the only clergyman, stickling for an ancient form of words, who puts his own quite up-to-date meaning into them. **P** is,after all, a sophisticated person, on our side of the great gulf that separates simple-minded barbarians like **J** from men of science and philosophers. The Book of Genesis, from verse one of its first chapter into verse four of its second, is not at all the "primitive Jewish folk lore" that it has too often been called by persons who lump **P** and **J** together. **P** is entirely respectable Mediterranean science, a hundred years later in date than Thales, "the Benjamin Franklin of antiquity," the experimental work of Pythagoras on the physics of sound, and the proof that the earth is a globe. By the time that Genesis 1 got its last editing and became Holy Scripture "once for all delivered to the Saints," the great period of Greek astronomy had commenced, Hippocrates had founded scientific medicine and formulated the oath that still binds every nurse and physician, Euclid had written a geometry that is still in schoolroom use.

Naturally, then, it is not at all difficult to show agreements between **P**'s cosmology and present-day opinion. **P** stands at the beginning of one of the two great periods of scientific discovery, much as Columbus and Copernicus and Galileo and Sir Isaac stand at the beginning of the other. **P** is essentially one of us, knowing good from evil, just as Newton is.

P's doctrine of creation is, however, complicated and by no means always clear.

"In the beginning," writes **P**, "God created [or *bara*-ed] the heaven and the earth." But did he mean by *bara,* to create out of nothing? Unquestionably, by about the beginning of the Christian Era, thanks apparently to the great Gnostic Bacilides, *bara* had taken on that meaning. But in 500 B. C. *bara* meant "to separate," "to cut out," "to manufacture." The Septuagint, two hundred years later than **P**, in Genesis 2:3, renders *bara* "begin." On the face of the text, therefore, **P** may be representing the Almighty as no more than a demiurge shaping preëxisting matter after the fashion of **J**'s Jahveh.

On the other hand, **P** is obviously both a philosopher and a scholar, and no bad sort of scientific man besides. He ought not to be saying anything so simple-minded.

Moreover, **P** is well into the period of Persian influence on Israel. Now, Mazdaism, somewhat early for anything this side of India, appears to have arrived at the notion of a self-existent Creator making the rest of the universe out of nothing. There is, then, nothing improbable in the idea that **P** also held to creation out of nothing, contrary to the general run of Mediterranean thinkers, who tend to make even the earliest gods no more original than the raw material of the world. Hardly, at this late date, can one hope to settle the point either way.

Most likely, **P** himself never really faced the problem. He was, after all, a priest; and priestlike, he was interested chiefly in scapegoats and heave-offerings, the distinctions between clean and unclean beasts, the elaborate ritual of Leviticus. He probably never thought much about what he meant when he wrote *bara.* The habit of noticing what one's words mean is rather modern, a gift to us, in part, from the Schoolmen of the late Middle Ages.

However, the only creatures other than men that are said flatly to have been *bara*-ed, as distinct from "brought forth" or simply "made," are "the heaven and the earth" and the "great whales." But "the heaven and the earth" are at least interpretable as no more than the raw materials of the present order; and the whales seem only a matter of form, a concession to the popular belief in Leviathan, Behemoth, and Rahab.

For Behemoth and Rahab and Leviathan are most certainly neither cetaceans nor yet the crocodile and the hippopotamus, but mythologic creatures after the general order of *Tiamat.* Rahab, in particular, is "the Great Dragon that lieth in the midst of his rivers." Leviathan is "the swift serpent . . . the crooked serpent . . . the dragon that is in the sea," and also is the "sky serpent" which in the waters that are above the firmament, devours the sun and moon at an eclipse. The idea, in short, in P's mind is that even the primeval dragons who fought the Babylonia divinities, even these are God's creation.

In brief, then, for P, God "made" rather than "created" all in which mankind is practically interested.

But the significant point of P's doctrine appears in his account of the origin of living things. "And God said, Let the earth put forth grass, herb yielding seed, and fruit tree bearing fruit after its kind, wherein is the seed thereof: and it was so. And the earth brought forth grass, herb yielding seed after its kind, and tree bearing fruit, wherein is the seed thereof, after its kind; and God saw that it was good. . . .

"And God said, let the waters swarm with swarms of living creatures, and let fowl fly on the face of the expanse of the heaven. And God created the great sea-monsters [i. e. Rahab, Leviathan, and Behemoth, who are individuals, not kinds] and every living creature that moveth, which the waters brought forth abundantly, after their kinds, and every winged fowl after its kind: and God saw that it was good. . . .

"And God said, Let the earth bring forth the living creature after its kind, cattle, and creeping thing, and beast of the earth after its kind: and it was so. And God made the beast of the earth after its kind, and the cattle after their kind, and every thing that creepeth upon the ground after its kind: and God saw that it was good."

Now the point of all this Priestly account of creation is that, although God saw everything in the way of living creatures that he had made, and, behold, it was very good, God really had not "made" anything in any primitive, Babylonian, Jahvistic sense. God said: "Let the earth bring forth," "Let the waters swarm," "Let fowl fly": and it was so. **P** gives us the thoroughly modern picture of a Creator who controls the powers of nature, not to work an occasional miracle, but for the orderly progress of his creation toward his predetermined end.

All this is, of course, a form of Creationism; for the creatures, once made, do not progressively evolve. But it is the higher Creationism, whose underlying philosophy is not different from that of our own modern Evolutionism. Pity it is that our present-day Creationists could not have read forward into Genesis 2 the world-view of the philosopher of Genesis 1, instead of forcing into P's mouth the crudities of Babylon and J.

So much for The Origin of Species. There remains The Descent of Man.

"And God said, Let us make man in our image, according to our likeness: and let him have dominion over the fish of the sea, and over the fowls of the air, and over the cattle, and over [the uncorrupted text probably was 'over the wild beasts of'] the earth, and over every creeping thing that creepeth upon the earth. And God created man in his own image, in the image of God created he him; male and female created he them."

Nobody knows what this passage means. "In his own image" has, indeed, often been taken to mean that God himself has arms and legs, whiskers, and a spinal column. But though such ideas are quite congruous with J's views—and equally with those of J's followers of the present day—and are the regular thing in all medieval Christian art, where God figures regularly as an old man, it is quite impossible that P should have intended anything of the sort. Possibly, being always a priest, he is using a traditional form of words with mental reservations. Possibly his "likeness" has nothing to do with bodily form. In any case, P seems to have quite outgrown all such ideas as mixing man's clay with divine blood, breathing a soul into his nose, or anointing him Prometheus-like with heavenly fire. If God in P's philosophy said, "Let us make"; then whatever he meant, "it was so."

As for "Let us make," the "us" is a long standing and unsolved problem. It may be a mere matter of grammar, the "plural of excellence"—only why just here and nowhere else? Or the "us" may be reminiscent of multiple Babylonian gods—probably Marduk addressing Ea. But why should the scholarly and critical P, with nobody knows how many editors following him, down to the close of the canon, why should he nod on so significant a matter. The gods might be "us" for J or E. For P, "the Lord our God is one Lord." Persons whose orthodoxy is less under suspicion than their sense of where things belong in history have even seen in the "us," not the members of a Babylonian triad, but the Persons of the Christian Trinity!

On the whole, the most common sense rendering of the "us" is that of the great Jewish scholar, Moses Maimonides, who died in Spain in 1204—of whom, proverbially, "From Moses to Moses there has arisen none like Moses." Maimonides says, in effect, that God has addressed, first the earth, then the waters, then the earth again, saying to each: Let you do so and so; and forthwith earth and water did. Now God turns again to the earth and continues in the same strain: Let us—that is to say, Let God and the earth jointly—make man. The earth is to "bring forth" his body as it has already brought forth the plants and the beasts. God is to create in his own image that which the earth can not furnish and the animals do not possess. Thus does P attack the perennial, unsolved problem: Why is man so like the beasts on one side, so unlike them on another?

At any rate, that is what P might have said consistently with his general opinions. After all, who should better know what a Hebrew priest and philosopher means than a Jewish philosopher and rabbi?

In short, supposing the second Moses to be correct in his understanding of the words traditionally attributed to the first, P's idea of the creation of man is precisely in line with his idea of the rest of creation. God ordains the regular processes of nature: they bring about the result. P's science is not always quite as ours. P's philosophy, for the most part, might be just off the press.

One must, then, if one is to understand correctly the history of creation ideas in general and the opinions of the Priestly element of Genesis in particular, be always on his guard against two somewhat common but quite erroneous opinions concerning both. One is that the first chapter of the Book of Genesis is in any sense a "poem of creation." The other is that the first chapter of Genesis, as a prominent divine has lately written, "merely took the old Semitic story of creation," or is in any wise, as it is often said to be by persons who ought to know better, mere "Hebrew folk-lore" or "Babylonian legend."

As for the first, Genesis 1 is indeed written in the grand manner, and the Hebrew tongue, unlike our own, does not draw the line between prose and verse, but passes freely back and forth from each to other. But Genesis 1 is always fundamentally *Wahrheit* rather than *Dichtung*. Whoever wrote it meant to set forth what he supposed really happened: he did not mean merely to exhibit his poetic skill.

As for the second, Genesis 1, read for what it says and not misinterpreted in the light of Genesis 2 and following, is thoroughly good science.

This does not mean that Genesis 1 is present-day science. Scientific theories come and go, and it is highly improbable that all our present-day opinions concerning nature will be good science a hundred years from now. But that will not make our present-day opinions any the less science or any more "poetry" than it is now, nor convert the least part of it into "European folk-lore" or "twentieth-century mythology" or "American legend." Whatever is a reasonable interpretation of known fact is science, no matter how much other fact, afterward discovered, make that interpretation obsolete. No alteration of opinion will, for example, ever make the Conservation of Energy or the Atomic Theory into myth or legend or folk-lore.

But the author of Genesis 1, whoever he may have been in the flesh, along with his good poetry and his admirable theology, is fundamentally a man of science, in the sense that he reflects if he does not originate about the only conclusions possible to persons of his time and place who tried to think scientifically concerning the problem of origins. We nowadays only partly agree with him, because we know vastly more facts than any man of his time could possibly have found out by any effort. But given the facts as known, **P** and his contemporaries reasoned just about as we should do now. One should not forget that when **P** wrote, Babylon was a scientific center quite comparable with Athens and Alexandria and Rome and Cordova and Bagdad and London in their great days. Before the text of the Hexateuch became fixed beyond further change, Babylon had a public library, the Lyceum at Athens had taught two thousand students at once, there was a college at Alexandria, staffed and equipped in quite the modern fashion, with a quarter million books, and on the whole distinctly a better place for a bright boy to get an education than is many a legislature-ridden State University in these United States of America in this year of grace.

P's opinions, in other words, as set forth in Genesis 1 and other passages of Scripture, though in form of words colored somewhat by his admirable theology, are essentially those of any competent observer and close reasoner who lived well south on the great Tigris-Euphrates flood-plain and took the trouble to reflect on what he saw under his eyes. He has, indeed, no idea of the enormous length of geologic time, though certain Greeks had already some glimpse of this; but even so, it is by no means certain that each of his seven days was just twice round the clock. Aside from this single point, **P** reasons just as we should do.

"And God said, let light be," most reasonably. The ancient world, down to about the beginning of the Christian era, thought always of a chaos of matter, commonly uncreated, which the gods reduced to order. Our current idea of a universe created and ordered simultaneously, is rather modern. But chaos and night always go together. Inevitably, the first step toward reducing chaos will have to be the creation of light.

But light, obviously, has no essential relation to the sun. The world is bright before the sun comes up; there is still plenty of light after the sun sets. Besides, there is really a great deal of light by night, and there are lamps and candles. Clearly then, the "greater light" exists "to rule the day," not to make it.

To be sure, the sun does appear sometimes to shoot out rays much as garden hose squirts water—but no sound reasoner will maintain that there is no water without the hose. Moreover, we must not forget that our present-day idea of light as mode of motion goes back only to about Newton's time, and did not really prevail until Sir Isaac had been dead nearly a century. Sir Isaac himself always thought light to be an independent substance, just as P did. So, quite reasonably, light is created on the first day; and the sun is created on the fourth, to be endowed with its portion of the preëxistent fluid, along with moon and stars and lamps and candles. "Light was"; afterwards some of it is distributed to its various containers.

But the world is mostly land and water, and any philosopher who essays to discuss its origin progressively in time, must make up his mind whether original chaos was dry earth which afterward became wet, or water which afterward showed dry land.

The ancient Iranians, living on a dry upland, put the land first. So, too, does the Jahvist account of creation; for, curiously, as our text now stands, the first rain on the new-made earth was that which introduced the Great Flood.

But **P**'s standpoint is always consistently that of southern Mesopotamia, where the great Tigris-Euphrates delta is visibly building out year by year into the head of the Persian Gulf, a hundred miles of new country within historic time. **P**, then, inevitably, starts creation with "the great waters," "without form and void," and makes the dry land first appear only after "the waters that are above the firmament" have been divided off by the sky, solid "like a molten mirror," from the waters of the Great Deep "that are under the earth." Nothing, in short, can be more logical.

But if the sea is older than the land, then, naturally, fishes rather than quadrupeds are the earliest of animals. Indeed, Thales, half a century before **P** wrote, had come to the same conclusion, apparently on much the same grounds. So the waters, in **P**'s narrative, on the fifth day "swarm with swarms of living things."

The birds most logically go with the fishes. Flying suggests swimming. The great soaring sea-birds and the shore-dwelling waders of beach and marsh are always more in evidence than the little upland warblers, or the mountain and desert birds of prey. Besides, the birds have scales on their legs. Altogether, therefore, the sea rather than the earth should bring forth the fowls of the air; though there was dispute all down through the Middle Ages as to whether the birds arose from water alone or from water and mud.

P's account continues, as before, essentially science. After the waters have swarmed with fish and generated the birds on the fifth day, "God said," on the sixth, "let the earth bring forth the living creature after its kind, cattle, and creeping things, and beast of the earth after its kind." Or as we should say in modern English, let the earth produce all sorts of animals, domestic animals, and small creatures whose legs do not show when they run, and different kinds of wild beasts; for the great proof-text of present-day creationism, "after its kind," is only the sixteenth century way of saying "all kinds of" as one sees at once in the flood narrative, in Genesis 6, which is also from P, and in Leviticus 11. In fact, "after its kind" is one of P's tricks of style, and any passage containing this form of words is always part of the P document.

Obviously, however, P's account of creation involves a vast amount of "spontaneous generation," and that nowadays is not good science. But spontaneous generation always has been good science almost up to within living memory. Lamarck, well within the nineteenth century, called upon to say why, if animals evolve, there are so many of the simpler kinds still with us, had to maintain that earth and water even now continue to bring forth all manner of lowly things precisely as they did on the fifth and sixth days of P's relation; and the work of Tyndall and Pasteur did not come till half a century later. The universal belief in the spontaneous generation of living things, without parents, out of earth and water and dead tissues, rests on sound if incomplete observation of the facts.

As for man, the moment one has the idea of any sort of progressive creation, by virtue of which the primeval world becomes by successive steps more and more like the earth we know, one is, by that very idea, forced to believe man is the latest of created things.

In other words, given a good observer and good reasoner, who lives in southern Babylonia any time within half a millennium of our era and who has adopted the general idea of a progressive creation, the order of his details in time is bound to be just about what **P** makes them to be. **P**'s account is, then, neither "poetry" nor "myth," but perfectly good Mediterranean science of its time.

Whether **P**'s theory of a progressive creation, divided into at least six stages, each of which advances the world and its inhabitants another step toward its final perfection, is "creation" or "evolution" is the question that we shall have to consider next.

CHAPTER IV

THE SCIENCE AND PHILOSOPHY OF CHANGE

ALL philosophizing, in a sense, involves picking types. That is to say, each philosopher—and really, for that matter, each non-philosopher—faced by "this buzzing, booming world," fixes upon some one feature that illustrates and epitomizes all the rest. Then he goes to work to show that all other aspects of the universe are only disguised cases of his type phenomenon.

Thus, for example, for Herbert Spencer, the baking of a loaf of bread out of dough—the illustration being, of course, Spencer's own—with its change of vague and sticky mass into crumb and crust, is the type and picture of all cosmic evolution "from an indefinite, incoherent, homogeneity, to a definite, coherent heterogeneity." If, again, one thinks of the macrocosm as essentially like his own mind, one is an Idealist. Or if his own body be the type of the universe—his body, that is, as the eighteenth century thought it to be, though not quite what we have discovered it is—then he is a Materialist, and a bit out of fashion nowadays. Or finally, if one thinks that the rest of things duplicate his whole psycho-physical personality, body and mind together, one and inseparable, then he is a Realist. There are only three possible metaphysics.

On the side of the Spencerian "knowable," there can, in the same way, be only two philosophies. Either one notices the changes that go on under his eye and decides that change is the most significant aspect of all things, and thus becomes, in general terms, an Evolutionist; or one tends to ignore the evident changes in the world and concentrates on the things that do remain, and so becomes, in general terms, a Creationist. Both sorts of philosopher see alteration; and both see fixity. The difference lies in which of the two aspects of things seems the more interesting. For one, the type of all is an egg: for the other a coin.

In other words, early man, long, apparently, before the dawn of history—as soon in fact as he began to reflect at all—made out that certain parts of his environment do not alter with the lapse of time—the stars, for example, and "the everlasting hills." The stars, in particular, come back each night precisely as they were the night before, or if the "wanderers" and the comets have changed location, the planets at least, round their cycles and return. If, therefore, one lives in a dry country where the stars are bright, and if one tends flocks through the dark, then is one pretty sure to think that the gods in the beginning made all things about as they are now, and that change is only on the surface. Creationism does, on the whole, go with a pastoral economy, a flat landscape, and a dry climate. With these, goes Monotheism and a timeless, changeless God.

But on the other hand, a people like the Greeks, with a rough country, and a varied seashore, and storms and growing crops, are more likely to think about the way things alter. Nature, for them, is varied and interesting; so they tend to believe in numerous, rather unimportant, nature gods who come and go, and in Evolution.

Yet the two conceptions seem never, in easy-going antiquity, to be sharply marked off from one another after our modern way. The Greeks, though they are preëminently the evolutionists of the ancient world, nevertheless believed in Fate, unalterable and behind all the gods; and they thought of matter as eternal, the substrate of all change.

On the other hand, there is not a little vague evolutionism in the Bible, along with its ever-present primitive transformationism. Even in Genesis 1, the Great Charter of Creationism, the cosmos alters from one day to another of creation week; and after the Fall, the serpent forfeits his limbs, while a new lot of thorns and thistles arise to afflict mankind.

Greek opinion had it—if one may summarize an intolerable deal of not very productive philosophizing—that the vastly complicated world as known has evolved from a quite simple origin.

Thales, about 600 B. C., noting the teeming life of the warm ocean at his feet, made water the mother of all things, much after the Babylonian fashion and the P account in Genesis. Apparently, for Thales, the waters, much after the style of Genesis 1, brought forth abundantly the moving creature that hath life, without much speculation as to detail. Thales is, of course, somewhat older than P. Evidently they both reflect wide-spread opinion.

Anaxamander, not quite a half century later, taught definitely that the first men are the offspring of the fishes of the primeval sea, and after the manner of J, makes mankind the earliest of land creatures. He is one of the first to formulate definitely the idea which every one else assumed, that many creatures, eels, for example, having no parents, are generated spontaneously out of lifeless matter. But he does not think that men ever grow up like plants directly out of the earth, autochthonously.

With about 500 B. C., in Greece, came in a fairly scientific evolutionism and the old four-element chemistry.

This four-element chemistry, which sees all things on earth, living and non-living alike, as compounds in various proportion of earth, water, fire, and air, is one of the fundamental ideas of the ancient world and of the Middle Ages down to the rise of our present-day experimental chemistry about the time of the French Revolution. It is, then, one of those basal theories, which like the doctrine of spontaneous generation, is an essential part of the background against which one has to view nearly all ancient texts.

One does not read correctly most of the old books that interest us, unless one reads between their lines that all objects are variously compounded of earth, air, water, and fire; and that one or more of these, by natural process, without special divine intervention, can generate a living thing.

"Fire" is the same thing as "ether," and forms the upper region of the sky just below the Heaven of the Moon. Angels and other ethereal creatures have their bodies of flame, and one sees them at night as shooting stars. The air also, for the ancient world, is no mere mixture of gases. It contains the Spirit of God, blowing as his breath, and it literally "animates" all who have "the breath of life." Thus, in P's account of creation "the wind of God," as a creative force, "was rushing over the face of the waters"; and in J, man "became a living soul" only when Jahveh "breathed into his nostrils."

One gets a vivid picture of what "air" meant before Lavoisier, by reading with the eye of imagination, that weird passage in Ezekiel (37:1-10), that no one understands unless he knows the history of chemistry.

"The hand of the Lord was upon me . . . and set me down in the midst of the valley; and it was full of bones; . . . and lo, they were very dry. . . . So I prophesied as I was commanded . . . and the bones came together, bone to his bone . . . but there was no breath in them. . . . Then he said unto me, Prophesy unto the wind . . . and say unto the wind, Thus said the Lord God: Come from the four winds, O wind, and breathe upon these slain that they may live. So I prophesied as he commanded me, and the breath came into them and they lived, and stood up upon their feet, an exceeding great army."

In other words, the ancient world, Greek and Jewish and Egyptian and Babylonian alike, saw fire as a great mystery, and air and wind the veritable spirit of divinity. Earth was the type and substance of everything dry, and water, the type and substance of everything wet. Out of these four anything could happen.

The *Nuremberg Chronicle,* for the year in which Columbus came back from discovering the New World, pictures the old earth with concentric spheres, water, air, and flame around it.

Water, earth, air, and flame, then, are not at all, for most of mankind, the mixtures and compounds of known elements or the processes of chemical union that they are for us. These four stuffs are, indeed, the familiar things; but they have all sorts of divine and magic properties of which we know nought. It was simple common sense to believe that living things arise when they all get together.

Empedocles, well after 500 B. C., formulated pretty definitely this primitive evolutionism, in which—to speak in very general terms—earth and water combine into mud or *Ur-Schleim,* the heat of the sun brings it to life, and the air endows it with spirit. All early peoples tend to hold vaguely this opinion. Curiously enough, Empedocles, like P and the Babylonian tablets, make the order of creation, first the earth, then plants, next the sun, and finally the animals. That plants, in all three systems, come before the sun—the last idea that one would expect to occur to anybody—does indeed suggest some sort of borrowing.

Meanwhile, the Greek investigators of nature had seen that fossils are the remains of animals formerly alive, and so got a hint at least, of the length of geologic time. They had, besides, made a beginning at a scientific embryology, so that they had before them in some detail that perfect model and type of the greater evolutionary process, the way the bird gets inside the egg and "how the bones grow in the womb of her that is with child." Curiously enough, all the Biblical authors somehow missed both these points.

This brings us to Aristotle, "the wisest of wise Greeks," "the Master of them that know," who is ever the great clearing house for scientific ideas, picking up and putting together all that preceded him, passing it on, together with his own contributions, to all succeeding time.

Aristotle was the real founder of Greek science—of science, that is, which stands on its own legs, rests directly on evidence, and keeps clear of philosophy. There was plenty of good science before Aristotle's time and outside of Greece; but he, first of men, saw the study of nature as a thing by itself, that is not to be mixed with philosophy or religion. His ideas spread themselves through the Mediterranean world and affected Israel along with other peoples.

Aristotle died in 322 B. C. But the Old Testament canon did not close till more than two centuries afterward; and the Old Testament books of Chronicles, Zechariah in part, Joel, Esther, Daniel, many of the Psalms and Proverbs, Ecclesiastes, The Song of Songs, and the whole Apocrypha, are later than Aristotle's *Natural History of Animals*. Much of the Old Testament, and all the New, was written by men who read Greek, and for whom Greek science was in the air. For the New Testament writers, in addition, Hebrew was virtually a dead language. All the quotations of the New Testament from the Old are from the Septuagint or related Greek versions.

Christian theology, therefore, developed in an atmosphere of Greek science, in which Aristotle's views of the origin of plants and animals were taken for granted as a part of the world-view of every educated man. Plato, to be sure, influenced the evolution of Christian dogma more than Aristotle did; for the early Church bothered little about the things of this world. But no Church Father would dispute Aristotle on a point of natural history. The great St. Augustine, who more than any other man finally settled Christian dogma, though a thoroughgoing Platonist in his philosophy, was thoroughly Aristotelian in his science.

Through still another channel, however, Aristotle's views entered the Christian Church and helped to fix the limits of Christian orthodoxy.

With the decay of western civilization during the Dark Ages, the remnants of Greek science were kept alive, and indeed increased, in Mohammedan lands, so that Aristotle and later Greeks became the teachers of Islam. After the Crusades and the resulting contact between East and West, much of this old knowledge filtered into Europe. In fact, as late as the thirteenth century a gifted and scholarly Christian youth, desiring freedom of opinion, might aspire to complete his education in Moorish Spain. "Algebra," "alcohol," and "zenith" still attest the source of much of our present-day knowledge.

Long before the invention of printing, the works of Avicenna and Averroës, though frowned upon by the Church, found their way somewhat freely into Christian hands. By A. D. 1200, the great European universities were on their feet, and Greek writings in Arabian dress were known of all Christian scholars. In fact, for Anslem and Aquinas and Duns Scotus and Albertus Magnus and Peter Lombard, the "Thus saith the Lord" of the Old Testament was no more important, mostly it got rather less attention, than "Thus saith Aristotle."

Now as a matter of fact—as anybody can verify from a history of Christian doctrine—precisely what is and what is not orthodox Christian dogma was finally decided, in large measure, by the Schoolmen of the eleventh and twelfth Christian centuries. We like to think that we get our theology out of the Bible. As a matter of history, we do get it mostly out of the "Platonizing" Fathers of the second century, and that remarkable group of medieval scholars and philosophers of whom St. Thomas Aquinas is the great figure.

But all these last were Aristotelians. They believed what Aristotle taught, on Aristotle's authority;

and they brought it about that pretty nearly whatever Aristotle taught concerning the earth and its living inhabitants, became also the teaching of the Church itself.

If, then, one wishes to know what Christian Europe, from the breaking up of the Roman Empire pretty well down toward the opening of the eighteenth century, really thought about creation, evolution, equivocal generation, and the general problem of living origins, let him turn back to Aristotle who determined most of it.

Aristotle held, in general terms, to the immemorial doctrine of spontaneous generation. He was one of the great naturalists of all time; and he recognized some five hundred, as we now say, "species" of mammals, birds, and fishes, knew most of the simple water creatures, and even recognized the sponges as animals. Specifically, for him, frogs, snakes and eels, among others, are generated from the mud.

But Aristotle's unique contribution to evolutionary theory is his idea of a ladder-like genetic series of creatures, from polyps to men, in which each term is the modified image of the one next below. As it turns out, of course, the evolutionary series is not ladder-like but branching—though various persons who ought to know better still follow Aristotle here. This, however, is a minor point. Aristotle was the first evolutionist in the stricter sense. He added a third theory of the origin of species to the two that had gone before. The actual creatures seen around us are not, all of them, thought to be either generated spontaneously out of water and earth, nor yet the unaltered descendants of an original creation. Some creatures, taught Aristotle, are the offspring by natural generation of ancestors altogether different from themselves. This and nought else, is in a strict sense, organic evolution.

Now, of course, the Bible does not teach any such idea; and Christian theology, resting fundamentally on Plato and Aristotle, but accepting also the Old Testament, had somehow to adjust Creationism and Evolution.

Augustine, among others, handled the problem neatly. The Biblical account is, after all, pretty vague; and the issue between various methods of creation is nowhere sharply drawn. In fact, the question, in any critical fashion, probably never occurred to any Biblical writer, for Israel was interested in more important matters. We think of Genesis 1 and 2 as strictly creationist. But that is only a traditional reading, and no very old tradition at that. Augustine came at the text with a fresh eye. Augustine was also sure that Aristotle is right and that the Bible agrees with him. Therefore, did Augustine, and the Church officially after him, read into the text of Genesis a good deal that would have much surprised either J or P.

The six days are, of course, not solar; for God works not in time, "from Whom time itself had its beginning." The "days" are, therefore, not intervals of time, but a series of causes. The heaven and the earth, the moon and the stars, animals, plants, and men, are "created" only *"potentialiter atque causaliter."* In other words, for Augustine, in the beginning God created in the primordial material of heaven and earth the potentialities of future evolution when the appropriate occasion shall by and by arise. For Augustine as for Aristotle, the type of the universe is the growing tree, whose parts are potentially, but not actually, in the seed. "Even so as in the grain itself there were invisible all things simultaneously, which were in time to grow into the tree, so the world itself is to be thought of, when God simultaneously created all things, as having at the same time in itself all things that were made in it and with it, when the day itself was created . . . in due time and after long delays, they grew up in such manner as they are now known to us, in those works of God which he is working even to the present hour." Both Augustine and Aristotle, in short, believed in a continuous creation that is always at the same time a creative evolution.

St. Augustine's "reinterpretation" of Genesis was rendered the more easy from the fact that neither he nor his master had ever heard of the distinction, so dear to the heart of the present-day theologian, between "miracle" and "natural law." Aristotle thought of his Prime Mover as the "efficient cause" of all that is, either by preordaining it from the beginning, or as constantly present in the workings of nature. Both Augustine and Aristotle, therefore, would accept quite naturally:

> "He maketh grass to grow upon the mountain
> And herb for the service of man."
>
> "He giveth snow like wool;
> He scattereth the hoarfrost like ashes;
> Who can stand before his cold."
>
> "If God so clothe the grass of the field."
>
> "Not a sparrow falleth
> But its God doth know."

All very much in the modern manner, and following out **P's** rather than **J's** world-view.

It is, of course, by no means true that all Saints and Fathers of the Church and all great philosopher-theologians of the Middle Ages accepted unreservedly the whole of Aristotle or any thoroughgoing evolutionism. There was, in fact, much opposition to both, especially during the period in Europe when the centers of culture were in Moslem lands. The Church often opposed Greek science, not because it contradicted the Bible, but because it agreed with the Koran.

Nevertheless, enough great churchmen were Aristotelians and Evolutionists—Augustine and Aquinas and Duns Scotus, and even in a way, John Wesley—to bring general evolutionary theories fairly inside the limits of orthodoxy. The Roman Church declares officially that a belief in the origin of animal and plant species by descent with modification, after the Aristotelian-Darwinian manner, is not formally heretical.

All this, however, is but one side of the picture. The Christian world, in general, followed Aristotle in believing in evolution by descent. It followed at the same time Genesis and Babylon in believing in special creation at the hands of some divinity. Along with both, it clung to the immemorial idea that the earth and the waters are bringing forth abundantly all the while all those swarming creatures that have not been seen to lay eggs, and that such plants as are not known to produce seed grow spontaneously out of the ground.

In other words, up to modern times, the issue had never been taken among three incompatible doctrines. Men accepted all three, uncritically.

All this, if one wants to think clearly—an ambition by no means shared by all mankind—brings up certain curious problems of definition: What is Creation? What is Evolution? If any sort of living creature is ever "equivocally" generated out of non-living matter, is the process "creation," because nothing new "evolved"; or it is "evolution" because nothing new has been "created"?

Now, creation has never been really defined. We speak—or at least some of us do—of a stunning costume as a "creation," and we all agree that a poem is such. Each spring, if we live in the country, the seedmen's catalogs describe for us "New Creations in Plant Life"—which are obviously nowadays evolutions after Mendel's law. We speak of a sycophant as a "creature."

Or if we turn to Genesis 1, we read:

". . . God created the heaven and the earth, . . . made the firmament, . . . made the two great lights . . . and . . . the stars also . . . created the great 'whales' and every living creature that moveth, which the waters brought forth abundantly . . . and every winged fowl. And God said, let the earth bring forth . . . cattle, and creeping thing, and beast of the earth after its kind. . . . And God made the beast of the earth after its kind. . . . And God said, Let us make man. . . . And God created man."

Evidently then, assuming that our translation is correct, "to create" is interchangeable with "to make"; and either is the same as "Let . . . bring forth."

But "make" means almost anything. We elders "make" beds and the morning train; and our offspring make faces at each other; and if we make money in one sense we land in jail, if in another we become pillars in the church. So "make" means anything from "shape" to "do"; and "create" is only a narrowed and strengthened "make." We get nowhere on this line.

Furthermore, the scientific creationists of the early modern days of natural history, if ever they tried to define "create," could only fall back on a vague and legalistic "act of God." If they knew or guessed anything about any creature's past history, they duly set it forth. If they knew nothing and could not guess, they said, God created it, as an easy way to explain that they did not know where it came from. Practically then, "*God* created" has always meant, "*I* don't know."

The word, "evolution," on the other hand, has had a rather complex history. Its mathematical meanings, getting the "involute" of a curve and "evolving" the roots of numbers, are, of course, old. Its earliest use in any biological sense was by a Swiss naturalist, Charles Bonnet, shortly before 1770, to mean the "unrolling" of leafy branch from its bud or young creature from its egg. That meaning the word still retains, though "development" or "ontogeny" are the more favored in this sense because of the ambiguities of "evolution."

When, however, early in the nineteenth century, the group of great embryologists of whom Von Baer is the best known, had established the general principle that each developing creature does always, apparently, in some sort of fashion, repeat the history of some part of the past life of the earth, it was inevitable that "evolution" should extend its meaning to include also this supposed ancestral development. So "evolution" came to mean "stem-history" or "phylogeny," a sort of animal genealogy where fossils take the place of town registers and tombstones. This is now its chief meaning.

But, alas, few are the objects in this world that have not some sort of history. And given any sort of history, one can always say that the narrative has "unrolled." So we have the "evolution" of the automobile, and the "evolution" of the one-act play, to say nothing of the evolutions of a fleet of war vessels trying not to run one another down. Evolution, in short, has so many meanings that it has come to have no meaning at all; and as a matter of fact, scientific people, among themselves, have rarely used the word. It has been said, incorrectly however, not to occur anywhere in Darwin's writing.

Still, one must somehow distinguish between "evolution" and "creation," if one is to follow out the history of either; and it so happens, for purely historical reasons, that the line has, more often than elsewhere, been drawn at "species." Conventionally, and indeed purely as a convention, and only because the problem in the eighteenth century chanced to appear under this guise, whoso believes that "species," as described in the botany or zoölogy that he chances to be using, are not derived from one another, is thereby labeled a creationist. And he is an evolutionist who believes that some of these selfsame organisms are more or less remote descendants of others enough unlike them so that if they ever got into the books at all, they would have different Latin names. "The origin of species by descent with modification" is Darwin's form of words, and is, in current usage, Evolution.

But, of course, there is no human being alive who does not opine that offspring may be progressively unlike their parents. A strict Creationist merely holds that they never become enough unlike to be called by different specific names. On the other hand, practically, whoever holds that the limits of species are transcended by progressive change, always extends the idea very much farther, and holds with Darwin to no more than a half dozen or so of separate origins for all earth's living things, or with Haeckel to only one. Therefore, for anybody living during the last century or so, the line between Evolutionist and Creationist is rather easily drawn.

For earlier worthies, as we have seen for Augustine and shall see for others, any such division is pretty meaningless. Mostly it is a matter of emphasis; so that, for example, Agassiz and John Wesley can be shifted from one camp to the other by a change of definition.

But, of course, we can not let people shift sides; and if we do not have definitions, how shall we maintain disputes! Let us, then, by way of putting some sort of meaning into our words, say that:

1. If a living creature arises directly out of "inorganic" matter or out of the dead flesh of another creature that was once alive, it is spontaneous, or equivocal, generation: transformation, but not strictly Evolution.

2. If one sort of living creature arises by natural generation—parents to child, out of the egg or the body of another sort of living thing, especially if it takes several or many generations for the process—that is Evolution.

3. If neither of these processes occur, or if no opinion is expressed concerning origins, we may call it Special Creation.

Something like this is probably the best working distinction among the three ideas. Nevertheless, it will not hold everywhere; and even where it does hold, the line is sometimes pretty fine. We count, for example, Genesis 1, as Creationist, because the divine command, "Let the earth bring forth," is, apparently, followed immediately by "the living creature after its kind"; and in Genesis 3, "cursed is the ground for thy sake" results rather directly in the "thorns also and thistles," that the sons of Adam still have to grub up. But if the bringing forth of the earth were strung along for some time or were thought of as continuing to the present day, then the same account would involve "abiogenesis." Likewise, if the thorns and thistles are thought of as growing out of seeds of "grass and the herb yielding seed after its kind," then the whole thing counts as Evolution.

Practically, it is often impossible to tell just which of the three ideas is at the back of an ancient writer's mind. More often than not, he does not know himself.

Besides all this, one must not forget—as people too often do—that even of recent years, most persons who have believed in evolution have also, at the same time, believed in some sort of original creation. Darwin is a conspicuous example of this. In his summing up of the *Origin of Species*, for the final sentence of the book, which he put last, hoping vainly that it would not be overlooked, Darwin wrote: "There is a grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, while this planet has gone circling on according to the fixed laws of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved." Augustine, as we have seen, also held to this idea of a universe created with the capacity and impulse to evolve; and substantially this has been understood to be Wesley's view. In general, throughout history, so far as the problem has arisen at all, men have tended to believe in a creation at the beginning which afterward underwent all sorts of transformations, skin-shiftings, and evolution.

Where, then, taking history through, is one to draw the line between creation and evolution, that is to say, between a creation followed by evolution and a creation that remains essentially unaltered to the end? Obviously, the world does somewhat alter. Historically, most men have set an original creation of some sort at the beginning of their evolutionary process. How much change may one admit, and still have his opinions admitted to a history of creation theories?

One really gets the clearest idea of what is or is not evolution by going back to the old mathematical use of the much-enduring term. "Evolution" is always literally a "rolling out." In particular, evolution is the rolling out of a string wound on a spool with a pencil tied to its end to mark the resulting line. In more technical terms, the evolvent of any curve is evolved from it by unwinding an actual or imaginary thread into a series of points, which themselves constitute another curve.

Every proper case of evolution, then, involves a series. This may be a series of points, as on the evolving curve; it may be a series of states in an evolving embryo or an evolving solar system or an evolving star; it may be the parent-offspring series which in current scientific opinion results in "descent with modification" of plant and animal species. But a series there must be. That which can not be put into a series is not the product of evolution.

The series, in addition, may not be an arbitrary one, after the manner of soldiers lined up in company front by stature. Each term of the series, whether a point in a curve or a race of organisms in a species or the developmental stages of an individual, must be causally related to the next before and the next after. Each must have just one place in the line, must be accounted for by what comes next before, and account for what comes next after. An extra man in uniform, coming late, can be put into the company front and nobody know the difference; but one can not put an extraneous point into a mathematical curve. Behind all the complicated and often vague meanings of "evolution" lies always the old mathematical idea of a tight series with every term accounted for.

A true evolutionary series, moreover, must not only be tied causally from term to term, it must in addition be also a series in time. The soldiers in company front are a row in space; they are not a series in time. On the other hand, Herbert Spencer's loaf of bread is a true case of evolution, because its several states succeed one another moment after moment as the dough rises and the oven bakes. In our evolved curve, which is the type and pattern of all true evolution, the successive points are always thought of as arising at successive instants as the string unrolls.

One is, therefore, entirely correct in speaking of the "evolution" of the automobile or the telephone. Each machine or instrument belongs in a series. Each season's design presupposes last year's, without which it could not have been conceived; and each year's design, in its turn, leads directly to next year's improvement. Most of our larger inventions, therefore, are also evolutions.

Even the "evolution" of a fleet of battleships, farfetched as the usage seems at first glance, is true to the basal idea of the temporal series. Each moving ship, from moment to moment, "rolls out" its wake, a continuous series of positions, each tied causally to those before and after. That captain and inventor might have done something other than they did, affects not at all the fact that whatever they do is an "evolution." When in doubt, look for a series, is the best of rules for locating the uncertain line that divides creationist from evolutionary theories.

Evidently, then, there is in all ancient thinking a great deal of transformationism that is not really evolution. Men believed in all sorts of discontinuous changes that do not form a series, along oftentimes with other continuous changes which do. Augustine, for example, is more or less of this sort.

J, on the other hand, is clearly non-evolutionary; because he thinks of literal pottering, followed by mere skin-shifting. **P** is not so clear. For the most part, **J**'s quite foreign ideas have been read back into **P**'s initial chapter, and **P** in consequence is made out to be thoroughly creationist. But **P** describes an orderly progress, day by day, from the original chaos "without form and void" to the ordered universe as known. There is, roughly indeed, a true series occurring in time with its terms in a somewhat inevitable order. But the series is, after all, pretty loose—the fishes, for example, do not in any sense determine the birds—and those who interpret Genesis 1 as the story of an evolution depart widely from dictionary meanings. Genesis 1 does indeed contain a series; but it is a series of independent creative acts—in short, a row rather than a series in the stricter sense.

Evidently, therefore, so long as men believe in transformation, either natural, miraculous, or magical, the issue can not arise between Creation and Evolution in any accurate sense. Practically, this means that the proper history of Creation Theory does not begin until men have given up witchcraft, and Aristotle has ceased to dominate their ideas. For purposes of this book, Creation shall mean all theories according to which the world since its beginning has not grown "serially" better or more varied or more like its present-day condition. To this detailed story we now turn.

CHAPTER V

THE COLLAPSE OF ARISTOTLE

IT IS by no means easy to sum up in any brief form the general opinions, philosophical and scientific, of a Christian scholar of the Middle Ages. The period itself lasted a thousand years, and saw within itself no little change. Christendom, at times, extended into Africa and western Asia, and always included such diverse lands as Italy and Ireland. Scholarly opinion was indeed, on the whole, at any one time, more uniform than it is now, because of the all-controlling Church. But even so, many men had many minds.

There is, moreover, yet another difficulty: we do not always know what men thought. Our own clear and accurate technical vocabularies within the fields of philosophy and still more of science, are themselves the products of a slow evolution, and on the whole modern. The Ancient World and the Middle Ages did not, in general, think clearly because both lacked words to think with. Whoso in his thinking broke through the limitations of his day, had no way to explain himself to his own generation or to posterity. We simply do not know precisely what were the real opinions of many great thinkers of former time; and students of their writings sometimes come to quite opposite conclusions as to their views. Even in those rare instances when the great figures of the past saw their problems in the same form in which the same questions come to us, their answers do not fit into our mental background; they do not state their results in our form. This is one reason why two hundred dissentient Christian bodies in the United States all extract their opinions from the same book.

At the same time, if one is willing to keep to very general terms and allow for many exceptions to each statement, one can say that something like the following will be, roughly, the world-view of a typical scholarly Christian in the days before the Renaissance, and his general opinions concerning the origin of species.

Such a scholar, in the first place, is utterly convinced that the road to wisdom is by way of the past. Learning, for him, is always the study of more ancient texts—Greek philosophers, Roman naturalists, the Hebrew Scriptures in their Latin dress, the New Testament, the writings of the Fathers of the Church —it makes no difference who an author is if only he has been dead a long time. He believes, also, thoroughly, in magic; and any sort of scholarly work in the field of what is now natural science, consists in stringing together extracts from older books, weird stories of half-fabulous animals, comment on mystic properties of gems and plants, accounts of quite imaginary ways of animals. Occasionally, much distorted, appears a sound observation out of Pliny. But the general idea that one can secure information about the world around him merely by looking at it, is something quite outside the ken of the entire learned world.

Thus, for example, century after century, the learned world repeats the story that the common salamander exudes an icy cold that puts out flame. But nobody after Pliny's day thinks to test the poor little creature at the kitchen fire. Up to the time of Vesalius, who died in 1564, all men supposed that all the sons of Adam are one rib short on one side, the missing member having gone into making Eve. For more than a thousand years, no man thought to notice his own ribs or count another man's. The only thing that the Age of Faith did not believe was its own eyes.

The earth, though known to be round, is thought to be stationary and inhabited only on one side. Some persons, however, on Biblical grounds, think the earth is flat. Surrounding the globe are the seven planetary heavens, as imagined by Dante or Milton and pictured on various ancient maps, with two, three, or four higher heavens outside them, all inhabited by saints and angels, divine beings of a half-dozen sorts, and the three Persons of the Trinity. Human souls that climb the Mount of Purgatory step off its summit into the Heaven of the Moon.

This universe, in size perhaps ten times the diameter of the earth, has been created in time, and not so very long ago. Nevertheless, the old Greek idea that matter is eternal still lingers as the opinion that the material of the world may be much older than its present form. Origen, in fact, held that God's creative activity is without beginning or end, and that an infinity of worlds has preceded this. Origen is, to be sure, doubtfully orthodox; but the present-day opinion that Genesis makes the present state of the *mundus* go back to the beginning, by no means always found favor with the Middle Ages.

As for the more interesting animals, the Ages of Faith took literally "let the earth bring forth." Old drawings show, for example, a lion at the creation, head and shoulders out of the ground, pawing frantically to get his hind legs clear. Milton also, in the seventh book of *Paradise Lost*, develops the same idea at characteristic length,

> ". . . . the ounce,
> The libbard, and the tiger, as the mole
> Rising, the crumbled earth above them threw
> In hillocks; the swift stag from under ground
> Bore up his branching head; scarce from his mould
> Behemoth, biggest born of earth, upheav'd

> His vastness: fleec'd the flocks and bleating
>   rose
> As plants."

The fact is, not only this picture of creation but a great deal else that is generally thought to be in the Bible, has really been taken out of *Paradise Lost* and is not in the Bible anywhere!

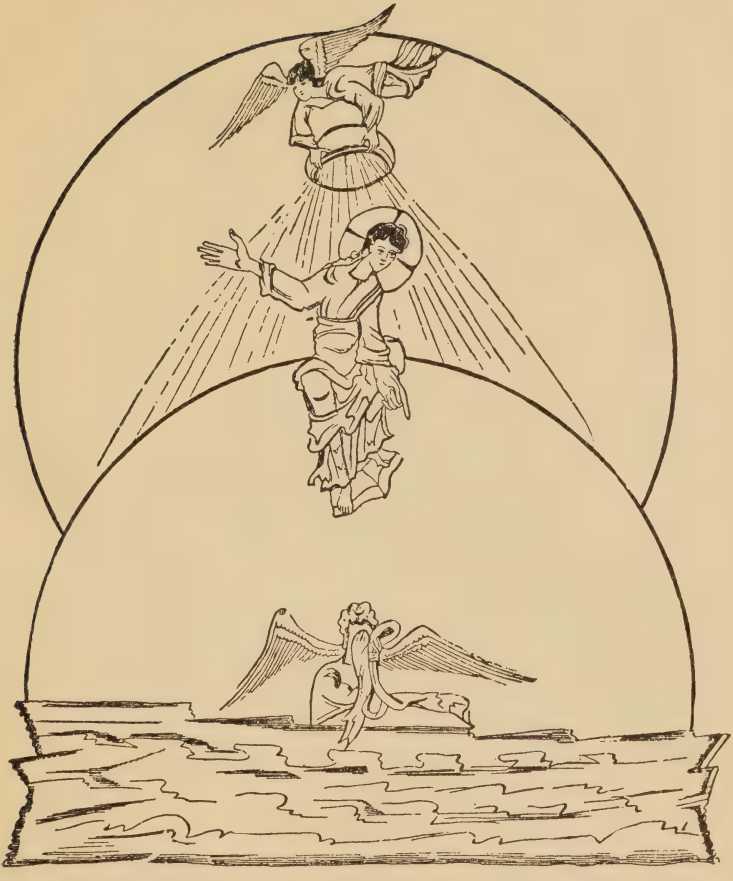
Fossils, when they are noticed at all, are not, in general, thought to be the remains of anything once alive. The earth forms them of itself, in place, or perhaps aided by "the influence of the stars." They may be discarded patterns left over from the creation, or they may be abortions which the earth has not brought forth. In any case, they are "sports of nature," spontaneous generation of the earth, like most living animals. Consistently enough, even a Roman vase, dug up from the earth, need not be any work of human hands. Not until after 1695 was it freely imagined that fossil shells are relics of Noah's Deluge—an opinion which still prevails more widely than one would expect. Altogether, Christendom took a long drop from Greek and Arabian geology.

The problem of equivocal generation worked out into a vast deal of specific misinformation. Bees and wasps are generated from the putrid carcasses of cattle and horses, and flies from any decaying flesh. But bees are also metamorphosed out of the dew. Serpents arise from the spinal marrow of dead men laid away in sepulchres—one sees the snakes any time crawling in and out among the stones. Orchid blossoms fly away as birds. Even as late as 1609, Claude Duret describes in print and figures a tree, "not, it is true, common in France, but frequently observed in Scotland," whose leaves falling into the water become fish, dropping on the land change into birds. Incidentally, the oyster comes ashore at dawn, to receive a drop of dew from heaven, which a ray of the rising sun alters to a pearl.

But the earth also brings forth directly, forming living things out of any warm mud.

> "Hence, without parents, by spontaneous birth,
> Rise the first specks of animated earth."

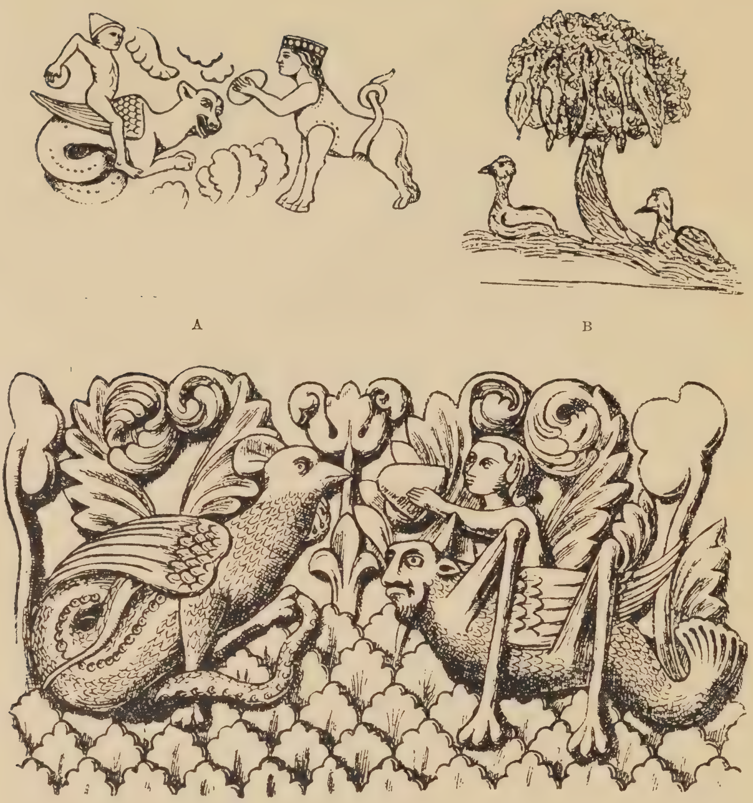
In general, of course, such creatures as have parents at all, tend, on the whole, to resemble them. There are, however, various exceptions. The dead phenix, for example, enclosed in an egg of myrrh, generates a worm from its decaying flesh; and the worm in turn, caterpillar-like, is transformed into the new bird. Sir Thomas Brown, in 1646, undertook to refute the belief in the phenix. A cock's egg "set" under a snake, hatches out a basilisk, with a cock's head and a snake's tail, for whose peculiar qualities no less a man than Pliny is authority and Shakespeare is to be quoted.



The Created Universe of the Early Middle Ages.

The Almighty, above, is creating light. Below, the Spirit of God is moving upon the face of the waters.

From the *Junian Manuscript* (probably tenth century) of Cædmon's seventh-century epic, *The Fall of Man*.



FOUR BEASTS OF THE MIDDLE AGES.

a—Sphinx and Basilisk. Carvings on a capital in the Abbey of Vezelai.
b—Barnacle Geese. From a Bestiary.
c—Basilisk and Winged Man-Headed Locust. Carvings from the Abbey of Vezelai.

From *Animal Symbolism in Ecclesiastical Architecture*, By E. P. Evans.
Courtesy of Henry Holt and Company.

About here, however, Albertus Magnus draws the line.

Benoît de Maillet, who lived into the eighteenth century, held that a flying fish may wander ashore, take to a diet of herbs, grow feathers and a beak, and thereafter found a line of proper birds. He held that lions are the offspring of sea-lions, men of mermaids, and, apparently, that the bottom-dwelling fish that wiggle through the mud, may wiggle ashore and become reptiles. De Maillet held also that his views are in complete accord with Genesis.

Even as late as 1872, the great embryologist Kölliker, who was one of the last Creationists to survive into the period of Darwin, holds that an egg does not always produce a creature at all like its parents, so that the same species occurring in different parts of the earth may really have several quite different origins, and be born of several different forebears unlike itself and each other. Xenogenesis is the technical name for the process; and the idea as a scientific theory goes back at least to the seventeenth century, while as a popular superstition it is immemorial.

All this heterogenesis and skin-shifting, foreign as it is to our most fundamental ideas now, has nevertheless a basis in fact. There are the tadpoles in every mud-hole altering into frogs. There are the silkworm caterpillars and their like, transformed into moths under our eyes. Why should any one suppose that "Like begets like" is any universal rule?

There are also the gall-flies, obviously generated by the tissues of the plant that forms the gall; and the seventeen-year locusts obviously brought forth by the earth where, for years, no such creatures have been. The seeds of every sown crop swell on planting as if beginning to rot, and they do rot if they do not grow. Obviously, then, as the Apostle writes, ". . . that which thou sowest is not quickened except it die; but if it die, it bringeth forth much fruit." In other words, the living plant arises always "equivocally" from dead seed. It all hung together consistently enough and quite reasonably.

For we must not forget that the Middle Ages had no microscopes, and so missed at least nine-tenths of what we see. As late as the eighteenth century, it was a remarkable instrument that would give four hundred diameters, against two thousand now, with vastly inferior definition and virtually nothing of our present-day staining and sectioning technique.

Moreover, up to the nineteenth century—and indeed well into that—virtually every naturalist was an amateur. Nobody paid him to sit down for a lifetime and get out all that can be learned from some one small aspect of nature, while somebody else digs away at another. Whoso, therefore, took any part of nature for his province, took it pretty much all. Such an all-round man of science was often most acute in observing and most intelligent in interpreting what he observed—but he saw only the obvious, and he rarely experimented at all. Altogether, then, the medieval, Aristotelian world-view and the medieval, Aristotelian science were inevitable.

Both the science and the world-view of Aristotle and the Christian Middle Ages collapsed suddenly, between the appearance of Copernicus's *De Revolutionibus Orbium* in 1543 and of Newton's *Principia* in 1687. The event, indeed, was being prepared for since the invention of printing, about 1440, though on the other hand, there are people still alive to-day who think the earth is flat, and other persons who still maintain various other pre-scientific opinions. But in general, in less than a century altogether, the seven heavens above men's heads came crashing down about their ears, while the firm set earth under their feet got up and started running round the sun. Then occurred the most rapid change of basal opinions in all history. Then, essentially, was our modern world born.

The result was the end of Aristotle as final authority on all knowledge. The astronomers proved against him that the earth moves. The physicists, Galileo here also in the lead, cut into his ideas concerning other moving bodies. Various naturalists questioned his anatomy. Above all, Francesco Redi, in 1668, disproved most of Aristotle's teaching concerning the spontaneous generation of creeping things, and so broke into the entire primitive evolutionism that went with it.

Aristotle's doctrine, nevertheless, rested on common sense experience. Most articles of food, left exposed, are promptly covered with mold. Many fruits, apples for example, too often have grubs at the core. Meat in particular, left to itself in hot weather, soon swarms with maggots. Evidently the molds and the grubs and the maggots are generated by the foodstuff. Redi, it appears, was the first of mortals to doubt so clear a proof.

Doubt it, however, Redi did; and being of Galileo's nation, and nearly of Galileo's time, he undertook to test the point by Galileo's method of experiment. His was a very simple experiment indeed: the wonder is that nobody for two thousand years had ever thought to try it, instead of resting satisfied with Aristotle's authority.

Redi, proceeding step by step, first exposed a dozen or twenty different foodstuffs, and the flies came swarming round them like Babylonian gods round a burnt offering. But Redi observed that each foodstuff hatched out all sorts of flies indifferently, and that these flies were always like those that had been buzzing about. That certainly looked more like eggs than like Aristotelian generation from decaying flesh. Redi buried his meat. It decayed—but there were no maggots.

Finally, he put his meat in jars and covered the mouths of the jars with fine-meshed "Naples veiling." The flies swarmed. The maggots appeared on the gauze. They did not appear in the meat. The case was clear.

Thus Redi proved that meat does not generate maggots and that flies do. However, Redi was a cautious and scientific person, who did not extend his theory to apple grubs and nutgall insects with which he had not experimented. Still less did he go to any such lengths as Harvey's *omne vivum ex ovo.* It took till the middle of the eighteenth century to disprove spontaneous generation for the animalcules of stagnant water, and well to the end of the nineteenth to do the same for the bacteria and the molds. Most persons past middle age can themselves recall the rise of the germ theory of disease.

It goes without saying that Redi got himself into trouble with the clergy of his day for denying the teaching of the Scripture as to the origin of small and swarming creatures. In particular, he had to face Samson's riddle in Judges,

"Out of the eater came forth meat,
Out of the strong came forth the sweet,"

a passage which certainly does declare the generation of living bees out of dead lions, at least as distinctly as most texts that have blocked the progress of knowledge. Fortunately, by 1668, scientific persons were beginning to reckon on keeping a whole skin, out of jail. Redi stood his ground against Aristotle and won. The practical result was to break down the whole ancient Greek and medieval Christian Evolutionism, and to swing scientific opinion strongly toward Special Creation.

Meanwhile, along toward 1700 and thereafter, the belief in witchcraft underwent somewhat rapid decay, although John Wesley, in his *Journal* for 1768 could still write that ". . . the English in general, and indeed most of the men of learning in Europe, have given up all accounts of witches and apparitions as mere old wives' fables. I am sorry for it, and I am willing to take this opportunity of entering my solemn protest against this violent compliment which so many that believe the Bible pay to those who do not believe it. I owe them no such service. I take knowledge that those are at the bottom of the outcry which has been raised, and with such insolence spread through the land, in direct opposition, not only to the Bible, but to the suffrage of the wisest and best of men in all ages and nations. They know well (whether Christians know it or not) that the giving up of witchcraft is in effect giving up the Bible."

However, in spite of the clergy, Wesley and others, juries of laymen after about 1700 simply refused to convict witches on any testimony, so that, on this point, the eighteenth century belongs to our own time.

With the passing of witchcraft went also all sorts of skin-shiftings by witches and devils, and all the immemorial belief in werwolves and the like. Thus the old transformations, attacked on two sides, completely broke down. Men ceased to believe in changes of form in beings once created. They ceased also to believe in any large amount of uncreated bringing forth by the earth of living animals and plants.

Paradoxically, the first fruits of a growing science deposed from authority the great master of all scientific thinking and set the Hebrew Bible in its place. This in its turn discredited all Greek evolutionism, and the "pottering" of J transferred to the general scheme of P, became for more than a hundred years both official theology and accepted science. But the process was slow, and a vast deal of adjusting had to be done in each generation to make the letter of Scripture fit each generation's knowledge of the natural order. Each generation, moreover, in its turn, as knowledge advanced, had the task to do over again.

CHAPTER VI

THE DATE OF CREATION

TO ANY ONE who attempts, sympathetically, to put himself in the place of pre-scientific man in Christian Europe, it must be evident that there never could arise anything that can properly be called a "theory" of Creation until the learned world came somewhat generally to accept Harvey's dictum, *omne vivum ex ovo.* Harvey died in 1657; and speaking broadly, by about that time or a little later, it came to be rather generally believed that however abundantly the earth may have brought forth during Old Testament times, the actual animals and plants that men saw around them had all sprouted from seeds, hatched out of eggs, or been born of mothers like themselves. In other words, as a matter of observation, known creatures do not arise *de novo.* Therefore does it follow that each ancestral line of animal, plant, or man, runs back unbroken to the beginning of all living things.

Of necessity, then, in place of vague notions that Jahveh pottered or the earth brought forth or God said, there tended to arise coherent theories that offer answers to detailed questions. There are the words of Scripture. There is also the testimony of the earth itself and its inhabitants. The one is infallible but indefinite. The other is at last coming to be studied at first hand after the manner of the Greeks and the Arabians. Gone are the simple-minded days when men answered all questions by consulting Aristotle.

Given, therefore, a growing science that is beginning to use all available data, with all sorts of vague and pious opinions tending to crystallize into coherent doctrines, there must needs arise four main problems concerning the original creation, namely:

Its time. In other words, How old is the universe?

The effect of the Great Deluge. That is to say, how far is the present condition of all things referable to Noah's Flood rather than to the original creation?

In what order did the various parts of the world as known take on their present form?

How far, if at all, has the world once created, and especially the living creatures on its surface, altered since either Deluge or Creation?

These four problems are by no means independent. Historically, in fact, they were all attacked more or less at once, with the same causes operating to compel successive solutions of each. Even so, however, for convenience and clarity, one has to take the four problems separately. We may begin most handily with the question of the Earth's age.

At first glance, the problem of creation date is simple enough. There is the Bible record, still unquestioned, and since Aristotle's eclipse, the final authority on all points. The Scripture is explicit: "Now these are the generations of the sons of Noah; . . . . Shem was an hundred years old and begat Arpachsad two years after the flood . . . and Terah lived seventy years and begat Abram. . . ." All, by the way, from the Priestly narrative, which runs to this sort of information. It becomes, then, merely a question of adding up men's lifetimes to the birth of particular sons until one comes to a known date.

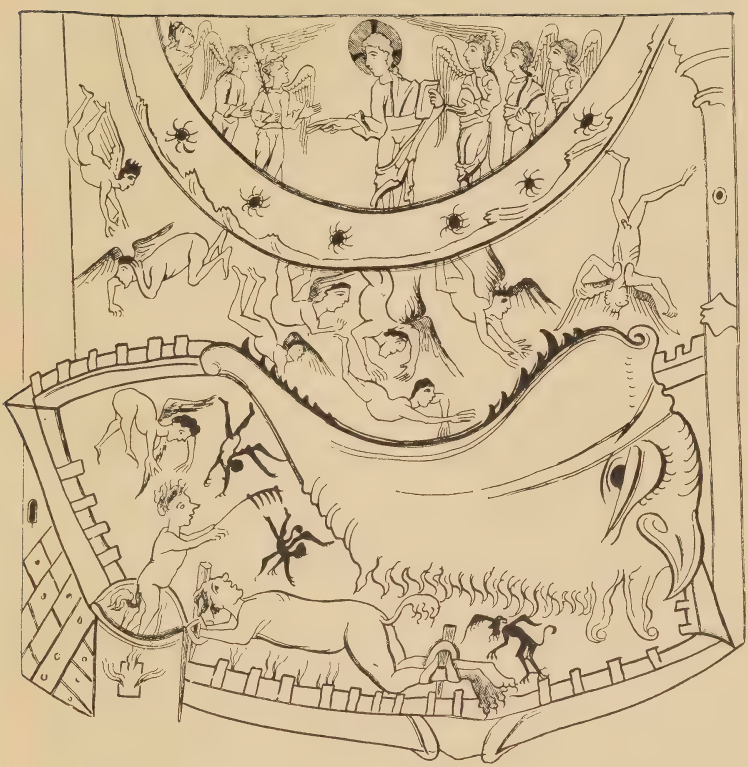
James Usher, Archbishop of Armagh in Ireland and one of the great scholars of his day, devoted to this problem two out of his sixteen erudite works, and reached the familiar conclusion that creation week was in 4004 B. C. After about 1700, Usher's dates were printed in the margin of the standard editions of King James's Bible; and there they still appear, widely regarded as no less authoritative than the text which they accompany. Within a half century of Usher's labors, another great divine and Hebrew scholar, Dr. John Lightfoot, by methods comprehensible only to a theologian, went a step beyond Usher's simple arithmetic, and placed creation week between October 18 and October 24 of 4004 B. C., with the creation of Adam on October 23, at approximately nine A. M., forty-fifth meridian time. Closer than this, as a cautious scholar, the Vice-Chancellor of Cambridge University did not venture to commit himself.

Unfortunately, however, both Usher and Lightfoot based their reckoning on the Masoretic text, that is both late and corrupt, no older, in fact, than the sixth century of our own era. King James's version rests largely on this text. But all Old Testament quotations in the New Testament are from the Septuagint or related Greek translations, which in turn rest on older Hebrew than the Masoretic, and have different and on the whole larger numbers in the P genealogies, the Samaritan targum, for example, making the date of creation 4710 B. C. and the Septuagint 5872 B. C. So the progress of Biblical scholarship, quite aside from any "opposition of science falsely so called," itself tended to discredit any attempt to fix dates by the letter of Scripture. With leeway of a thousand years among different Biblical manuscripts, men tended to listen more than they otherwise might to the testimony of the rocks.

In southern Europe, moreover, that is to say in the district least affected by the Protestant Reformation, no small amount of sound pre-Christian science lingered still. At the same time, the nearer contact of Mediterranean lands with the east and south permitted an infiltration of Moslem science to a greater degree than into the Protestant countries of the northeast. Old Greek ideas, therefore, of an earth much older than six or eight thousand years never altogether departed from men's minds. Modern geology, in consequence, took its rise in Italy.

But if any weight whatever is to be given to the facts of geology, the problem of the date of Creation turns, in last analysis, on the nature of fossils. If fossils in general, and in particular fossil shells in the stratified rocks, are truly the remains of creatures that were once alive, then it follows that the fossils as we now find them have been buried either suddenly in some great catastrophe or slowly by the gradual sifting down of sand and mud over them. But if fossils were slowly buried, then the process of burying them must have been enormously long. In addition similar strata not containing fossils must also have been laid down bit by bit. Altogether, then, if fossils are genuine relics buried slowly, the world must be a great deal older than Usher's six thousand years.

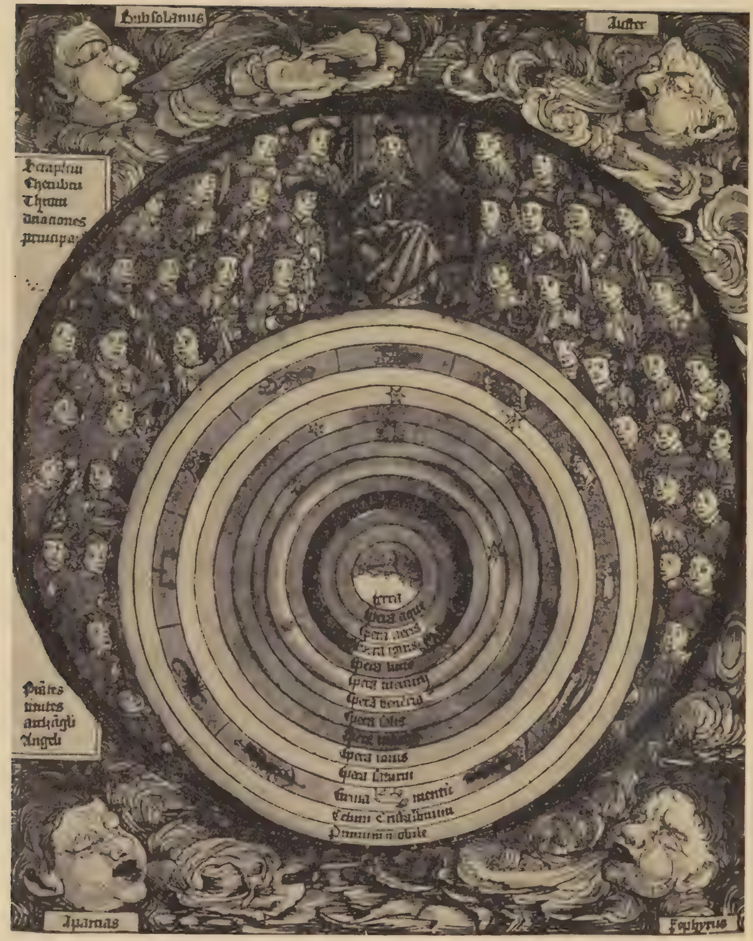
Early creationist opinion, therefore, tends to disparage all fossil remains. They are spontaneous generations of the earth that were never properly "brought forth," they are models which the Divine Artificer discarded after use, created on the first day to guide the operations of the third, fifth, and sixth; they are the result of an *aura seminalis* or of germs



THE THREE-STORIED UNIVERSE OF THE EARLY MIDDLE AGES.

''The Glory King of Hosts'' with his faithful angels, stands on the floor of heaven, above the stars; rebel spirits fall through the air into the mouth of hell.

From the *Junian Manuscript* (probably tenth century) of Cædmon's seventh-century epic, *The Fall of Man.*



THE CREATED UNIVERSE OF THE LATE MIDDLE AGES.

The Seventh Day of Creation Week.

The Earth, at the center, is surrounded by the three other elements, water, air, and fire. Outside these are, successively, the heavens of the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, the Starry Firmament with its twelve Zodiacal Signs, the Crystal Sphere, and the *Primum Mobile.* Surrounding all, is the Empyrean, where sits the Almighty attended by the nine ranks of celestial beings as listed at the left. At the corners are the four winds. Since the rotation of the *Primum Mobile* causes day and night, the Greeks, who knew that the earth rotates, omit this from their "Ptolemaic" scheme. Still other versions omit the Crystal Sphere, which takes care of the precession of the equinoxes.

From *Nuremberg Chronicle,* 1493. Courtesy *Harvard College Library.*

in the air that had fallen into crevices and developed inside the rocks; they were formed of "fatty matter set into a fermentation by heat" or by a "lapidific juice"; they are "sports of Nature," "mineral concretions," creations of "plastic force"; they were thought, wherever they came from, to reproduce themselves inside the earth, as metals also were supposed to do, after the fashion of the proper animals and plants above ground. In any case, they are not the remains of any creatures that have ever lived; for as Augustine quite properly declared, "Nothing is to be accepted save on the authority of Scripture, since greater is that authority than all the powers of the human mind," and the Scripture is taken to teach a creation doctrine into which living things now fossil do not fit.

Nothing better shows the mental state of mankind during the early modern period in Europe than does the time it took to dispose of this notion that all fossils wherever found are part of the original creation. Leonardo da Vinci, who died in 1519, held the current modern opinion, and argued his case convincingly on evidence that all men could examine with their own eyes. But Falloppio of Padua, who was both Leonardo's contemporary and his fellow countryman, insisted that even an elephant's tusk dug out of the ground in his time was only an earthy concretion, and thought it on the whole most probable that Roman vases unearthed in his own city were merely natural impressions stamped in the soil, presumably at the creation. Bernard Palissy, shortly before 1600, is thought to be the first who in Paris dared to assert against the prevailing opinion, that the familiar petrified shells and bones had once been parts of molluscs and fishes; and three contemporary naturalists who maintained the same opinion had their books burned and were themselves banished by the theological faculty. Dr. Theodore Arnold, writing in 1733 that fossils result from "infinitesimal particles brought together in the creation to form the outline of all the creatures and objects upon and within the earth," seems to have been about the last author to maintain the doctrine of created fossils with any considerable approval from the learned world. Nevertheless, the opinion remained entirely respectable for about another century.

Philip Henry Gosse, for example, brought out in London in 1857 a book of three hundred and seventy pages, illustrated with some sixty figures, and called *Omphalos,* that is to say, literally the navel, and figuratively the central principle, adequate in his own words to "untie the geological knot."

Now Philip Gosse—who was, by the way, father to Edmond, and so hero of the latter's *Father and Son* —was not in the least a closet philosopher, sitting under his lamp and evolving a universe out of his inner consciousness. On the contrary, Gosse was a fellow of the Royal Society, a thoroughly competent zoölogist, with a working knowledge of botany, acquainted at first hand with his local fossils, author of a half dozen books on natural history, a skilful and successful popular lecturer. In particular, he was one of the first students of the psychology of the simpler animals—his own special subject being the sea-anemones—and so really a founder of our present-day Behaviorism; and he was the leading authority of his time on British marine invertebrates. In fact, Gosse, at just about the time when he wrote *Omphalos*, was one of the small group of naturalists whom Darwin took into his confidence and whose advice he sought before offering that epoch-making paper of 1858 before the Linnæan Society. Gosse has been read with scant sympathy, interpreted with little justice, and held up to derision by persons of, at best, no more skill in arguing their opinions and of conspicuously less acquaintance with the facts involved.

Gosse reasons, in effect, thus:

All animals and plants as we know them run through a life cycle, starting as germs, ending in old age. Creation, therefore, for each created thing, must begin somewhere in the cycle. Adam, for example, must have started as baby or child or youth or man; he could not have been all at once. Of necessity, in

Gosse's own phrase, "Creation must always involve the sudden bursting into a circle."

Such breaking into the life cycle can not, in general, occur at any very youthful stage. The young creature is often helpless. Oftentimes, moreover, the immature condition of one species presupposes the adult stage of something else—the larva of the cabbage butterfly, for example, presupposes the full grown cabbage on which it feeds, the nut-weevil is hatched inside the nut, the sheep-bot larva lives inside the frontal sinuses of the grown sheep, the egg of the cuckoo-fly is laid nowhere else than in the body of wild bee's grub, which in turn is laid only in decayed wood. Gosse, with great learning, piles up cases upon cases where one creature must needs have been created old if some other creature is to live at all.

But every creature, Gosse continues, no matter how young, still more if adult, bears in his body the story of a past development. The tree has its annual rings, the rattlesnake its yearly rattle, the stag the tined horns that mark its age, the nautilus successively each

> ". . . chambered cell
> Where its dim, dreaming life was wont to
> dwell."

This point also, Gosse develops with vast learning and most convincingly, facing always a real problem.

Each new-created thing, therefore, argues Gosse, unless it was fundamentally unlike the same sort of thing now, bore in its tissues on that first day the signs of a youth that it had never had. Adam, for example, was presumably created as a young adult. But unless Adam was a different sort of man from the rest of us, the hairs of his head had a living base inside the skin and a shaft outside that is not much but horn. Each hair, then, presupposed a history of at least some weeks. His teeth showed the parallel lines of growth where the ivory grew inward from the enamel organ of a non-existent babyhood; his bones showed the ossification centers from which they had not hardened. In brief, if Adam was created about twenty-five years old, as tradition has it, then every organ and tissue of his body was precisely as if he had actually lived twenty-five years with his nine months gestation added on. Adam otherwise was no proper man.

In fact, Gosse carries out his logic so consistently as to maintain against Sir Thomas Brown and others that Adam must have had a navel. Error, wrote Sir Thomas, "there may be in the Picture of our first Parents, who after the manner of their Posteritie are bothe delineated with a Navill: and this is observable not only in ordinaire and stayned pieces, but in the Authenticke Draughts of Vrbin, Angelo, and others. Which, notwythstandynge, cannot be allowed, except we impute that vnto the first Cause, which we impose not on the second; . . . that is, that in the first and moste accomplyshed Peece, the Creator affected Superfluities, or ordayned Parts without all Vse or Offyce." But Gosse will have it that the first man, in every respect absolutely, was precisely like his sons after him.

In other words, to put Gosse's argument in a slightly modernized form, Adam, and with him every living thing at the beginning, was created a going concern. He had oxyhemoglobin in his arterial blood, although that blood had never been through any lungs, and reduced red pigment in the blood of his veins, which had never washed a muscle. By no possible test, argues Gosse, could Adam, ten seconds after his creation, be distinguished from any man of his apparent age.

So likewise is all inanimate nature also from its creation a going concern. The rivers started, fed by springs, running full. The ocean currents and the winds were a complete circulation of air and water at the beginning. A twelfth-magnitude star four thousand light years away from the new-made world was created with all its wave train of light clear to the bounds of space. And fossils, that are also essential parts of a going universe, were created in the rocks as if they also had a past.

"It may be objected," continues Gosse, "that, to assume the world to have been created with fossil skeletons in its crust,—skeletons of animals that never really existed,—is to charge the Creator with forming objects whose sole purpose was to deceive us. The reply is obvious. Were the concentric timber-rings of a created tree formed merely to deceive? Were the growth lines of a created shell intended to deceive? . . ."

"These peculiarities of structure were inseparable from the adult stages of these creatures respectively, without which they would not have been what they were. The . . . tree, without concentric rings, . . . could not have been an exogenous tree at all. The *Dione* could not have been a *Dione* without those foliations and spines that form its generic character. . . ."

"To the physiologist this is obvious; but some unscientific reader may say, Could not God have created plants and animals without these retrospective marks? I distinctly reply, No! not so as to preserve their specific identity with those with which we are familiar. A Tree-fern without scars on the trunk! A palm without leaf-bases! A bean without a hilum! . . . A Tortoise without laminæ on its plates! . . . A Bird without feathers! A Mammal without hairs, or claws or teeth, or bones, or blood! . . . I have indeed written the preceding pages in vain, if I have not demonstrated, in a multitude of examples, the absolute necessity of retrospective phenomena in newly-created organisms."

Moreover, he goes on to say, ". . . if I have showed that in one solitary instance an animal or a plant was created with but one solitary evidence of pre-development, the principle for which I contend is established. . . ."

"Admit for a moment," Gosse continues, ". . . that the Creator had before his mind . . . the whole life history of the globe, commencing with any point which the geologist may imagine to have been a fit commencing point. . . . He determines to call this idea into actual existence, not at the supposed commencing point, but at some stage or other of its course. It is clear, then, that at the selected stage it appears, exactly as it would have appeared at that moment of its history, if all the preceding eras of its history had been real. Just as the new created Man was, at the first moment of his existence, a man of twenty . . . or thirty years old; physically, palpably, visibly, so old, though not really. . . ."

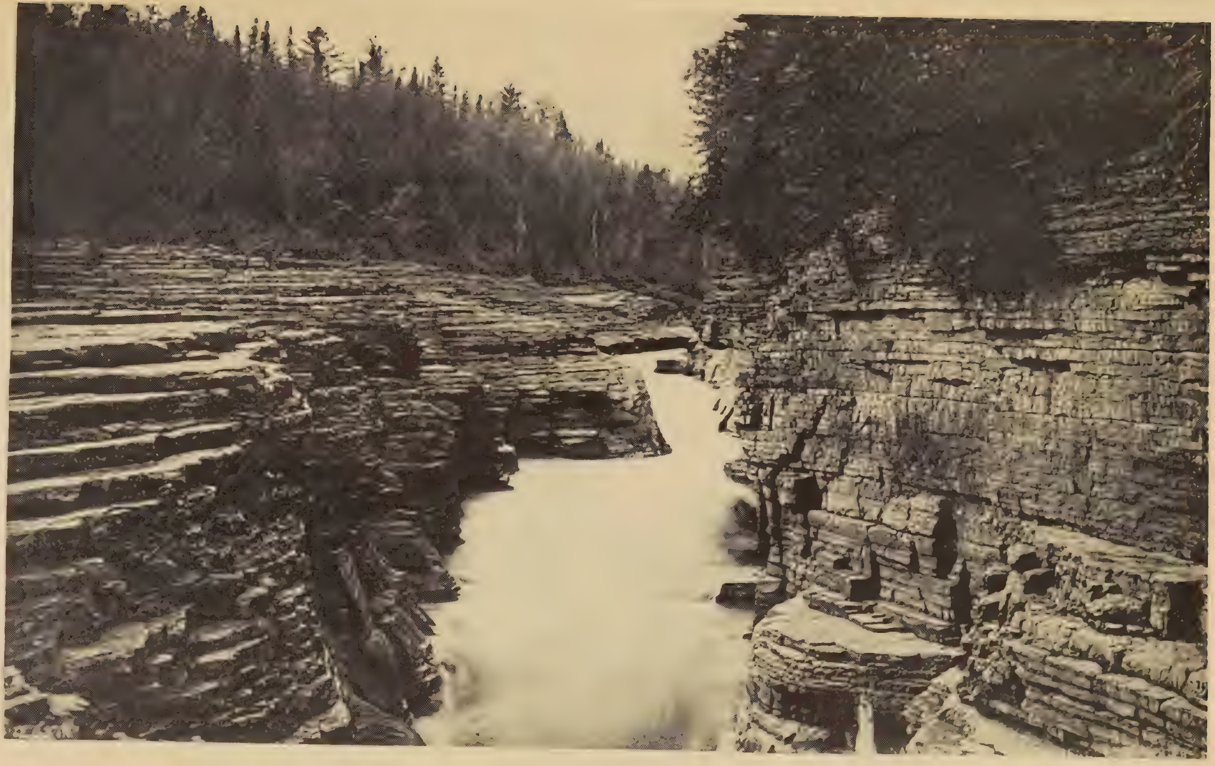
"Let us suppose that this present year 1857 had been the particular epoch in the projected life-history of the world, which the Creator selected as the era of its actual beginning. At his fiat it appears; but in what condition? Its actual conditions at this moment:

whatever is now existent would appear precisely as it does appear. There would be cities filled with swarms of men; there would be houses half-built; castles fallen into ruins; pictures on artists' easels just sketched in; wardrobes filled with half-worn garments; ships sailing over the sea, marks of birds' footsteps on the mud; skeletons whitening the desert sands; human bodies in every stage of decay in the burial grounds. These and millions of other traces of the past would be found, *because they are found in the world now;* they belong to the present age of the world; and if it had pleased God to call into existence this globe at *this* epoch of its life-history, the whole of which lay like a map before his infinite mind, it would certainly have presented all these phenomena; not to puzzle the philosopher, but because they are inseparable from the condition of the world at the selected moment of irruption into its history; because they constitute its condition; they make it what it is."

In brief then, for Gosse, the long ages of geologic history are "*ideal* and not *actual* time." ". . . the duration was projected in the mind of God, and is or was not really existent." The fossils are "an essential constituent of the Great Plan of nature," "they exhibit the skill and power of God in creation, they are a rich mine of instruction, affording some examples of the adoption of structure to function that are not yielded by any extant species." But they exist "only in the Divine Conception"; they never were alive; they give no hint of the earth's age; and the book closes with "In six days Jehovah made heaven and earth, the sea, and all that in them is."

One misses most of the point of this story of the first scientific form taken on by the Creation Theory, who thinks this opinion of Gosse and others merely absurd. If Jahveh ever really planted a garden eastward in Eden, then by all reason and by all imagination, the trees should have leaf scars and growth rings, all teeth and shells should show accretion lines, and every mammal should have an *omphalos*. In any event, the trees will have to grow out of soil, and soil presupposes always humus, built up by the action of soil organisms, bacteria and others, out of the decay of earlier vegetation, while shells and teeth presuppose lime in the water that has dissolved out of still earlier stuff. Only one who does not know how nature actually proceeds can imagine a world really new.

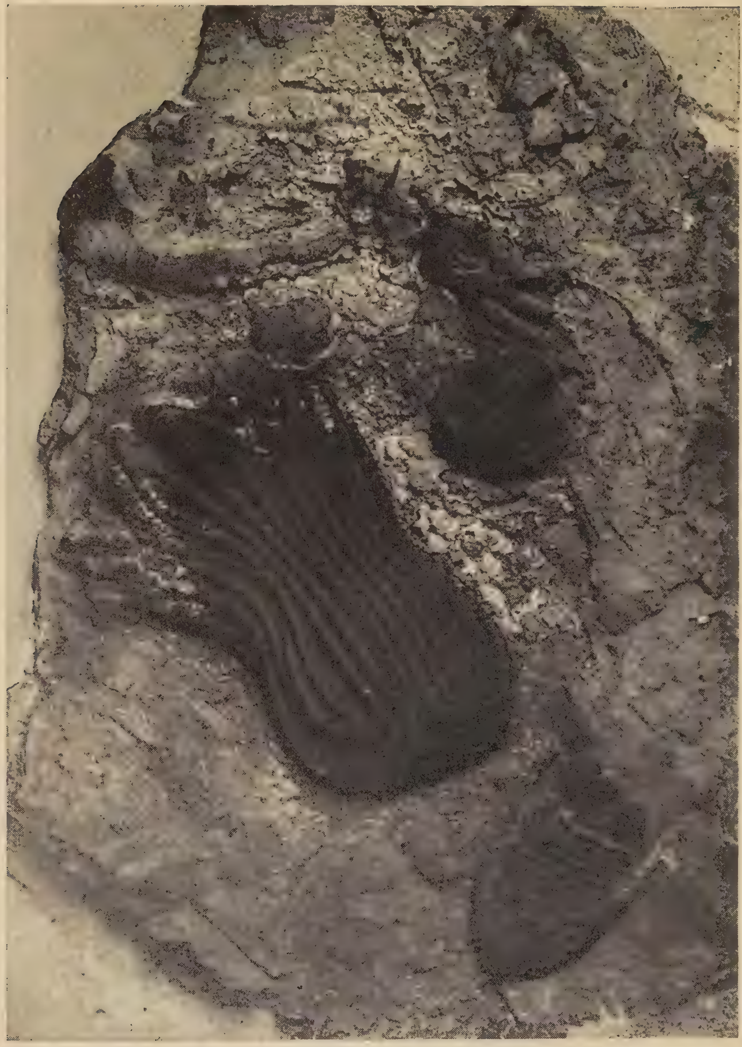
Gosse, then, is fundamentally right. If anything was ever really "created," then some fossils were, even though they were no more than the half-decayed leaves and twigs in the upper layers of the soil. It is the weakness of all theological creation theories as distinguished from scientific, to lose sight of the whole idea of the world and each creature in it, as always



Old Sea Floors.

Undisturbed strata of Paleozoic age from central New York. Each layer was once the upper surface of the ocean bottom, that was later buried under a new layer of mud, which in its turn became the sea floor on which the life of that time went on. Thus, the fossils at each level show the animals and plants that were alive before the next stratum settled down on top of them; and the succession of fossils shows the succession of local creatures from the bottom layers up.

Harvard University Collection.



Paleozoic Fossils from Central New York.

Tentacles of a crinoid or sea-lily; fragments of another head. Fragments of stems, the joints of which are ''Cuthbert beads.'' A trilobite and a brachiopod. All three are characteristic Paleozoic forms, abundant in the rocks of Great Britain and Continental Europe but not found now in any of the neighboring seas.

the going concern, and therefore to substitute a vague verbal formula for the sharp mental picture of what must have occurred.

Logically, then, there is no refuting Gosse; and if one assumes that God did create fossils that had no past, there is no limit to be set to the Almighty's power, and all such creations might just as easily be as numerous and as perfect and as convincing as they actually are. But men will not, in the end, set logic above eyesight. The fern leaves in the coal are too detailed, the flies in amber are too completely flies, shells and teeth are too much the real thing, to be passed off as either "concretions" or "essential constituent of the great Plan of Nature." Half-digested food fossilized inside fossil ribs, fossil young inside a fossil pelvis, fossil footprints and healed fractures, simply will not be explained away. The theory of created fossils held on for about three hundred and fifty years after the early Italian geologists had gathered ample evidence to dispose of it on grounds of common sense, but in the end it had to go. In general, theories of that type that depend on logic and outrage common sense,

> "To no such aureate earth are turned,
> As buried once, men want dug up again";

and the notion seems never to have been revived.

So ends the initial phase in the evolution of a scientific Creation Theory. If the world is to begin in B. C. 4004 and take only a week in the making, some other way than direct creation will have to be found to account for fossil animals and plants.

CHAPTER VII

THE DELUGE AS CREATIVE AGENT

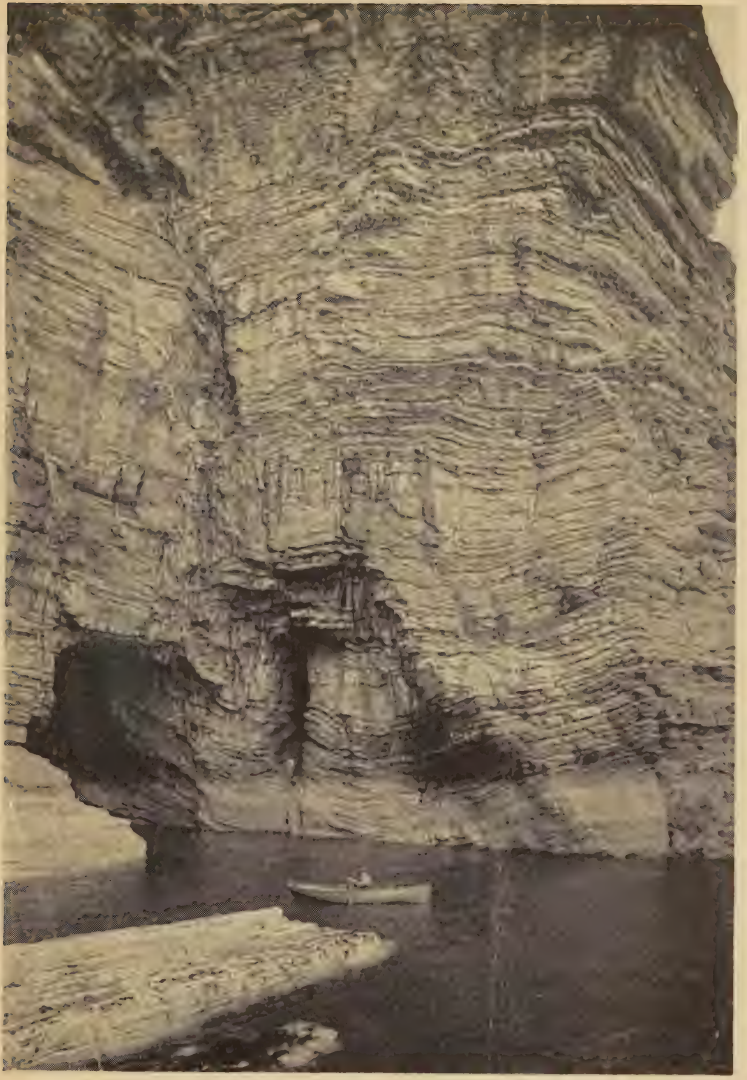
SUPPOSE, then, one abandons all idea of fossils as "stones of a peculiar sort, hidden by the Author of Nature for his own pleasure" or created as they are just to get the creation under way, one is forthwith faced by still another problem. Actual fossils are characteristically, for the most part, the remains of sea creatures. As soon, therefore, as one admits that fossil shells have ever been alive, there is no escape from the conclusion that wherever fossil sea shells now are, there sometime the sea has been.

Herodotus saw this long ago, and maintained in consequence that all lower Egypt and even the high country about Memphis has been under water. Aristotle, with his usual insight, puts the matter thus: "The distribution of land and sea in particular regions does not endure throughout all time, but it becomes sea in those parts where it was land, and again it becomes land where it was sea. . . . As time never fails, and the universe is eternal, neither the Tanais nor the Nile can have flowed forever. . . . So also of all other rivers; they spring up, and they perish; and the sea also continually deserts some lands and invades others. The same tracts, therefore, of the earth are not, some always sea and others always continents, but everything changes in the course of time." Strabo, who wrote in Latin just at the beginning of our era, had already arrived at our own current doctrine that makes the earth seesaw up and down locally, changing land to ocean back and forth. The conclusion, in short, is obvious if only men do not shut their eyes to the facts.

Arabian writers of the late Middle Ages expressed the same essentially modern opinions; so that, between the Greek and Roman authors whose works survived and the Moslem authorities who could hardly be refuted without being read, southern Europe at least was pretty familiar with what would have to follow if fossils were admitted to be genuine remains.

Not only, however, on the theory of fossils as real animals, must the ocean have once been well over the tops of the Alps. If the strata are real beds, formed by piling layer upon layer of earth by wave and river, then these strata must have been laid down nearly horizontal. But visibly, the strata of Alps and Apennines are not horizontal and regular but broken and twisted by gigantic forces, moved about like things of no weight, and in many instances stood up edgewise at right angles to their first position.

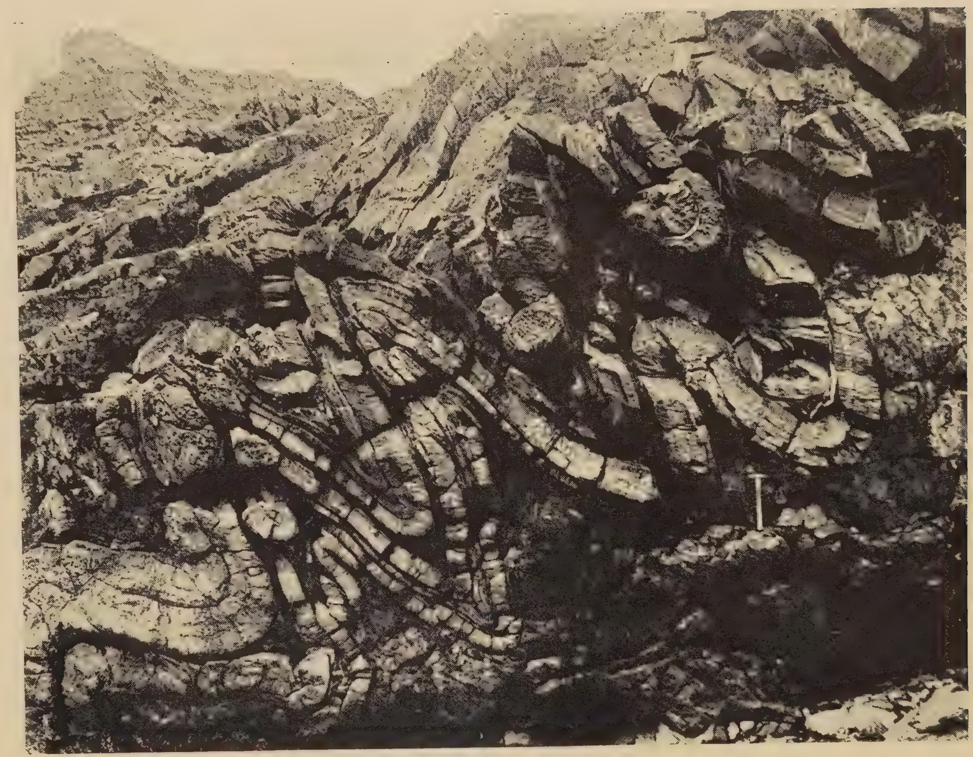
Arabian men of science, for example Mohammed



SEA CLIFF ON THE ISLE OF MAN.

Strata of a Paleozoic sea-floor somewhat bent and cracked during changes of level. These faults and folds have been interpreted as brought about when "the fountains of the great deep were broken up" at the onset of the Great Deluge.

Harvard University Collection.



An Overthrown Fold. Scottish Highlands.

Strata of black slate and limestone have been so crumpled in the process of mountain-building that now, in places, they are actually upside down. When in a large mountain system such overthrowing occurs on a vaster scale, a considerable fragment of geologic history will appear locally to be precisely reversed, older strata above, and younger below.

Photograph by the Scotland Geological Survey.

Kazwini in the thirteenth century, following out Greek ideas, saw that such changes of level and such breaking and distortion of mountain rocks might come about gradually, as we now know them to do, through various causes, during the long time that the earth has endured. But Christian theologians, limited to six thousand years of time, yet forced to admit both the organic nature of fossils and the displacement of rock strata, must perforce fall back on a quick-working catastrophe of some sort.

For them, obviously, the way out was the Great Deluge. The second form of the general Creation Theory, therefore, makes the present state of the earth go back, not to the Creation in 4004 B. C., but only to the Great Deluge of Noah, to which Archbishop Usher confidently assigns the date B. C. 2348 and the Septuagint locates at about 3200 B. C. All fossils are, then, remains of animals that lived before the universal Flood and were buried by it. Strata as known were laid down by the flood waters. All the present-day land animals, together with all mankind, are descended from the cargo of the Ark. In general and for all practical purposes, the world is not six thousand years old, but only a little more than four. This is the earliest and the simplest form of the Deluge Theory.

In this form, the flood theory of fossils is about as old as Christian theology. Tertullian and Augustine held the opinion, and St. Jerome maintained that faulted rocks exhibit the wrath of God against sin. Luther argued the view vehemently and at some length—as one would who called Copernicus an upstart astrologer and a fool. To his influence especially we probably owe the long survival of this ancient doctrine in Protestant lands.

For survive it does, preached still from many a pulpit and taught as the latest scientific opinion in not a few denominational schools. There is a college text-book of geology now on the market—not, one hardly need say, by any working geologist—seven hundred pages in length and expensively brought out, at latest accounts actually in classroom use, which teaches that all sedimentary rocks of the earth were laid down by the Great Deluge in a single year, with all the creatures in them, from Cambrian trilobite to Pliocene elephant, drowned at once and buried over.

There is also now on the market at least one elementary high-school text-book in general science that sets forth the same opinion; and as late as 1926, an instructor in biology in an American college wrote under caption, "Five Reasons Why I Teach Creationism":

"All the actual facts from geology confirm the Bible record of the Flood. The stratified rocks are everywhere filled with remnants of former life, packed in such enormous numbers that it is impossible to find anything to-day that in any way corresponds to them. Land and sea types are mixed in confusing abundance, while every evidence goes to show that the burial of the fossils took place by means of violent waves of water. Vast graveyards are filled with fossils, all showing plain proofs of having met their deaths by sudden and unusual forces of nature. . . . The theory of uniformity fails absolutely to give any satisfactory explanation; but the Flood story, if taken as a literal world catastrophe instead of a local affair, and if studied in its scientific aspects, furnishes a complete and consistent picture of the origin of the geological formations."

To be sure, the passage quoted has all its facts diametrically wrong. Fossils of any sort are on the whole rather uncommon, land and sea types do not occur together, living shells were never more numerous locally than now—no fossil snails, for example, are ever more numerous than the common brown periwinkle now is, alive, all along our north Atlantic coast above Cape Cod—and fossils are characteristically buried quietly in slowly settling mud, as anybody can see for himself by looking at present-day seashore and comparing this with the old rocks. But the passage does make clear, along with other evidence, that the form of the Creation Theory that makes the Deluge one of the main agents in forming the world that we know, is still current opinion, set forth in text-books, preached and taught and believed, as it has been continuously since the first Christian centuries.

Probably the most famous exposition of this second form of the Creation Theory, and certainly one of the most illuminating, is that contained in Thomas Burnet's *"Telluris Theoria Sacra,"* which he composed in Latin shortly before 1690, and then under orders of King William of Orange, whose chaplain he was, rewrote in English under the title, "The Sacred Theory of the Earth: containing an account of the Original of the Earth, and of all the general Changes which it hath already undergone, or is to undergo, till the Consumation of all Things."

It was a notable book in its day, patronized by royalty, reviewed with high praise by Steele in the *Spectator,* panegyrized by Addison in a Latin ode, translated widely into European tongues, and greatest honor of all, satirized by Butler in *Hudibras.*

"He knew the seat of Paradise,
Could tell in what degree it lies;
And, as he was disposed, could prove it
Below the moon, or else above it."

For various of Burnet's contemporaries still held to the older geography, set forth, among others, by Dante, that puts the Terrestrial Paradise at the top of the Mount of Purgatory, above the clouds and just under the Heaven of the Moon. But Burnet maintained against this view that the Garden of Eden was on earth, not indeed in Mesopotamia, but rather in the southern hemisphere about under the tropic of Capricorn.

Burnet's work, as Buffon said later, was really an historical romance; but his own age took it as a work of profound science and a much needed vindication of Holy Scripture against the attacks of geologists, astronomers, and others. Newton's Gravitation is, of course, anathema, for the *Principia* was hardly off the press when Burnet wrote; but Descartes is in high favor, and the general method of the book is to combine notions taken from Descartes with scriptural proof-texts picked up anywhere in Old Testament or New, and jumbled together without rime or reason to fit the Sacred Theory. The method, one observes, is not even yet obsolete.

Burnet takes quite the opposite view concerning the causes of the Flood from that of the Jahvist narrative, in which there is no mention of the Great Deep and all the flood waters fall through the windows of heaven from the storehouse above the firmament. For Burnet, the earth before the Deluge not only enjoyed a uniform and delightful climate like perpetual spring from equator to poles, with no rain heavier than the gentle dew, it was mathematically round and smooth, without mountains or seas or islands or rocks "with not a wrinkle, scar, or fracture," and all creation was alike equally perfect. In fact, there could not have been any oceans or even any lakes and rivers before the Great Deluge, else contemporary sinners would have mastered the use of boats; and so saved their lives in spite of their iniquities.

Burnet's original earth is like an egg, a thin shell of rock on the outside concealed by soil and vegetation; within are the Waters of the Great Deep, making up most of the earth's mass. As the result of human sin, the fountains of the Great Deep are "broken up," either by command of God, or, as other authorities held, by advent of a comet or stroke of the Almighty Hand. In any case, the earth's crust cracked to bits, the waters that are under the earth welled forth to drown all land creatures outside the Ark and bury their remains in the stratified rocks. So we have now, everywhere on earth, the twisted and faulted strata that are the fragments of a ruined world and the fossils in the rocks that are the animals and plants that perished in the great catastrophe. By and by there will come a general conflagration, and out of this second chaos will arise the new heaven and the new earth of the blessed millennium. Burnet had a truly Miltonian imagination, coupled with a lofty and effective style, and no small learning. No wonder his opinions have maintained themselves even to the present time, albeit greatly altered in detail.

These were the days before the rise of scientific geology, when nobody who cared to achieve fame as a geologist ever looked at a rock, but all the learned world betook itself to its study and excogitated a "system" based partly on Biblical proof-texts and partly on second-hand and largely erroneous information as to the state of nature. As the learned stonemason, Hugh Miller, put it some half century ago, geology, not yet having attained to the dignity of a science, "lacked solid footing as it journeyed amid the wastes of Chaos; and now tipped, as with its toe-points, a crude consistence of ill-understood facts, and now rose aloft into an atmosphere of pure conjecture, on a tumultuous cloud of ill-digested theory."

This fashion held, roughly, to about the time of the American Revolution, when observing laymen began somewhat generally to replace a speculative clergy as first authority. The Geological Society of London was founded in 1807, and that date may conveniently be taken to mark the beginning of the end of the Flood Theory as serious geology, and the starting point of strictly modern science. Buckland's *Reliquiæ Diluvianæ* is of 1823; and though by 1840 Buckland himself had altered his mind, yet the first of the Bridgewater Treatises by William Kirby, F. R. S., revised in 1852 by Thomas Jones, Professor of Comparative Anatomy in King's College, London, and also Fellow of the Royal Society, contains no hint that Noah's Deluge was not universal, and the one great agent in geologic work.

Notwithstanding, however, all this wild theorizing by persons who, as Voltaire said, were as fond of changes of scene on the face of the globe as are the populace at a play, created a universe with a word, and put themselves in the place of God to destroy and renovate the world each after his own fashion, there were, even in Burnet's day, no small number of local observers and collectors who gathered local fossils and cracked local rocks—mute inglorious Huttons and Lyells, who knew quite well that all the fine-spun "systems" of their betters would not at all hold water if brought down to earth. Profitably, then, we may quote at some length the words of a correspondent of the great botanist, John Ray, from a letter written in March of 1698, by one Edward Lhwyd whose name has perished otherwise but whose "small geological hammer" was even then cracking to bits a theory that was still to be dominant for more than a century in the learned world.

"Honoured Sir,

"You are pleased to ask, whether, after some Years

Observation, I have been at length able to satisfy my self, as to the Origine of what we call *Marine Fossils,* and those other Bodies no less surprizing, which (to distinguish them from other Plants) I have taken the Liberty to call *Mineral Leaves, viz.* Whether I conclude, with the general Opinion, that they have been reposited in the Places we find them, at the universal Deluge, and so preserv'd to our Time: or that they are original Productions of Nature, there form'd from some Plastick Power of Salts, or other Minerals, which was the Conjecture of the late Dr. *Plot,* and other experienc'd Naturalists. To this I must needs answer, That the frequent Observations I have made on such Bodies, have hitherto afforded little better Satisfaction, than repeated Occasions of Wonder and Amazement; forasmuch as I have often (I may almost say continually) experienc'd, that what one Day's Observations suggested, was the next called in Question, if not totally contradicted and overthrown. Nevertheless, so indefatigable is the Curiosity, and indeed so successful have been the Discoveries of this present Age, that we are daily encouraged to hope, this so important a Question will not not much longer want its final Determination, . . . I therefore at spare Hours, continue to improve my Collection, in regard it may be hoped, that from an accurate Inspection of it, some others hereafter may frame several useful

Inductions, which I myself never had the least Thoughts of. . . . But in regard it is necessary, that before any new Opinion be proposed, Reasons be offered against those already received, give me leave here to lay before you some Objections. . . . To begin, therefore, with that which refers all those Marine Fossils and Mineral Leaves, Stalks, and Branches, *&c* to the Deluge, I have several Reasons to offer against it, . . .

"*First,* therefore, As to the Marine Fossils; had these Bodies been Spoils of the Sea, brought on the dry Land by an Inundation, they would (for the Generality of them at least) either have been left on the Surface of the Earth, or have been lodg'd at no very great Depth under it: but I have found them buried (or inclos'd) within solid Marble on the *Face* of *broken* Sea Cliffs, of the Height of 200 Fathoms and more, from the Tops whereof to the Bottom, . . . nor was that only upon the Face of these Rocks, but even, more or less, throughout the whole Mass of them. And this is manifest from divers Rocks hewn down by Workmen for making of Lime, and other pieces casually fallen from the Cliffs. . . ."

"E. L." as he signs himself, goes on, first to cite his cases in England, Wales, and Ireland, that he has himself observed, and then argues that by no flight of fancy can any imaginable Deluge distribute shells, in general uniformly, through a mass rock, so that "the Sides or Walls within our Lime-stone Caves"—examples always given, for anybody to verify—shall exhibit *"Cuthbert Beads,* or *Entrochi,* which are the *Vertebrae* of Sea-stars"—that is to say, crinoid stems—and "several Remains of Cockles," "sunk so deep from Top" of the land above the cave.

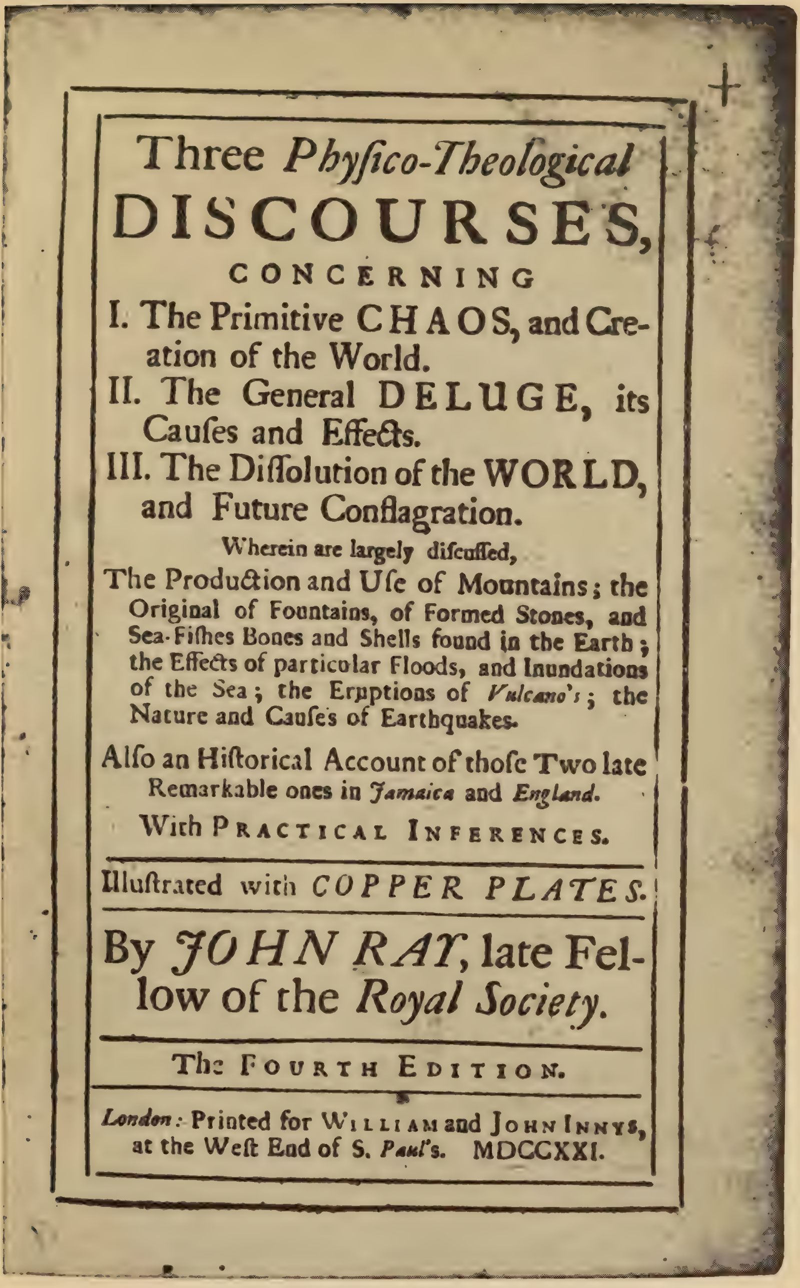
"Thirdly, The third Reason for my questioning whether all these Things be the Effects of the Deluge, is, for that the Bones, Horns and Hoofs of Land-Animals, are very seldom, if at all, found inclos'd in solid Marble, or other Stone; whereas seeing all perished in the Deluge, the Spoils of the Land might be expected (in Proportion) as well as those of the Sea."

"Seventhly, The immense Quantity we have of Marine Fossils, seems no wise to plead for the Origine from the Deluge: For we may observe many thousands of great Stones, and even broken Pieces of Limestone Rocks throughout *Wales,* and the North of *England,* [where, as throughout Ireland, the strata are Paleozoic] almost wholly compos'd of those *Vertebrae,* or broken Pieces of the *Radii* of Sea-stars, which are commonly called *Fairy-Stones,* and *Cuthbert Beads:* whereas 'tis very rare to find on our Shores, three broken *Radii,* or Fragments of any Sort of Sea-stars close together. Likewise one shall rarely find in the same Place, two single Teeth of any Fish on all our

Coasts; whereas thousands of these fossil Teeth, exactly answering those of divers Sorts of Sea-fish, have been of late Years found in Quarries and Gravel-pits about *Oxford;* nor is their quantity at all diminished upon breaking new Ground."

The point is that the enormous number of fossils of a single sort found together locally, indicates an original colony undisturbed by any sort of catastrophe, and precisely not the wash of any Deluge.

"*Ninthly,* Another Obstacle of my Assent to their being all of Diluvian Origine, is the vast Number of unknown Marine Fossils, so commonly met with throughout most Counties of *England;* such as we have nothing like, neither in our Sea Shores, nor rak'd by Dredges out of the Bottoms of the Sea, by the Oyster Fishermen, and others who have been employed by curious Persons on set Purpose. I have in my Collection above forty different Species of the *Fossil Nautili,* or those Shell-stones, a great many Sorts whereof are commonly call'd *Cornua Ammonis;* and have observ'd Plenty of most of these Species (broken or whole) in the Fields, Quarries, and Claypits of the Midland Counties of *England.* . . . And yet I cannot understand that all our *British* Seas afford one Sort of this Shell." As naturally they would not, since these are the famous "ammonites" which commenced their remarkable evolution early in the Devonian,



Three *Phyſico-Theological*
DISCOURSES,
CONCERNING
I. The Primitive CHAOS, and Creation of the World.
II. The General DELUGE, its Cauſes and Effects.
III. The Diſſolution of the WORLD, and Future Conflagration.

Wherein are largely diſcuſſed,
The Production and Uſe of Mountains; the Original of Fountains, of Formed Stones, and Sea-Fiſhes Bones and Shells found in the Earth; the Effects of particular Floods, and Inundations of the Sea; the Eruptions of *Vulcano's*; the Nature and Cauſes of Earthquakes.

Alſo an Hiſtorical Account of thoſe Two late Remarkable ones in *Jamaica* and *England*.

With PRACTICAL INFERENCES.

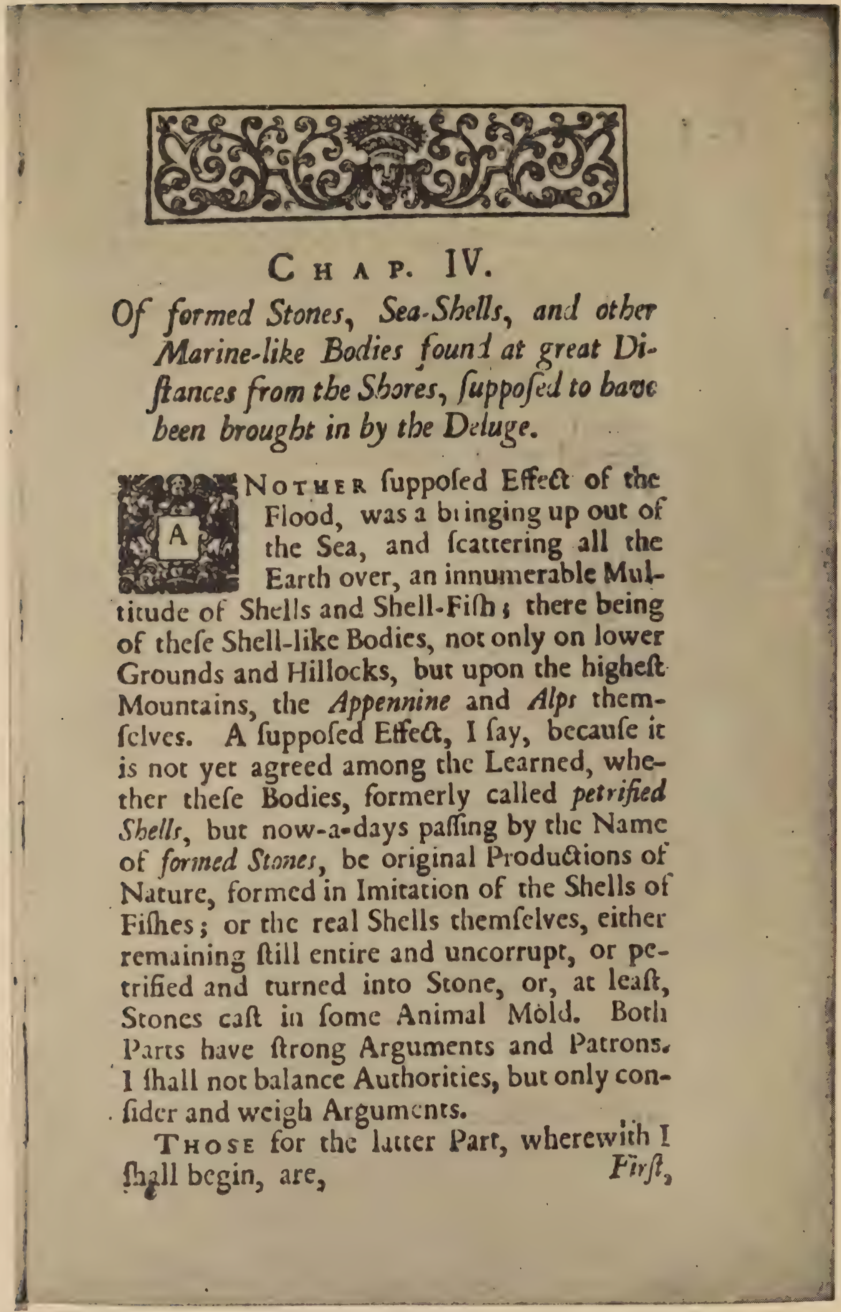
Illuſtrated with *COPPER PLATES.*

By *JOHN RAY*, late Fellow of the *Royal Society*.

The FOURTH EDITION.

London: Printed for WILLIAM and JOHN INNYS, at the Weſt End of S. *Paul's*. MDCCXXI.

Title page of *Three Physico-Theological Discourses* by John Ray.



CHAP. IV.

Of formed Stones, Sea-Shells, and other Marine-like Bodies found at great Diſtances from the Shores, ſuppoſed to have been brought in by the Deluge.

ANOTHER ſuppoſed Effect of the Flood, was a bringing up out of the Sea, and ſcattering all the Earth over, an innumerable Multitude of Shells and Shell-Fiſh; there being of theſe Shell-like Bodies, not only on lower Grounds and Hillocks, but upon the higheſt Mountains, the *Appennine* and *Alps* themſelves. A ſuppoſed Effect, I ſay, becauſe it is not yet agreed among the Learned, whether theſe Bodies, formerly called *petrified Shells*, but now-a-days paſſing by the Name of *formed Stones*, be original Productions of Nature, formed in Imitation of the Shells of Fiſhes; or the real Shells themſelves, either remaining ſtill entire and uncorrupt, or petrified and turned into Stone, or, at leaſt, Stones caſt in ſome Animal Mold. Both Parts have ſtrong Arguments and Patrons. I ſhall not balance Authorities, but only conſider and weigh Arguments.

THOSE for the latter Part, wherewith I ſhall begin, are,

Firſt,

A text page for *Three Physico-Theological Discourses.*

made their great splurge in the Jurassic, and disappeared off the earth before the end of the Cretaceous. The fact that the local fossils of any district are characteristically not the local living forms has always been the weak spot in all Flood Theories of Creation.

Ray's correspondent then proceeds at no small length to develop the same argument from the "Mineral Leaves" of the coal and other strata: They occur deep inside the earth, where no Deluge could possibly put them—and they are not British species. In other words, let any one imagine what he would expect the Flood to do. The facts of observation are precisely opposite.

So "E. L." has to fall back on the alternative theory, difficult as it is: the fossil shells and teeth and bones and leaves are no remains of any living things, but have grown in the rocks where they now appear, and he argues ingeniously and at great length for this opinion. That fossils may be the remains of living things and yet not washed in by Noah's Flood, simply does not occur to "E. L." Neither does it occur to John Ray, although Ray was, besides being the precurser of Paley in the realm of natural theology, on the whole, the foremost British naturalist of his day, a man of uncommon sincerity and candor for any age, and one of the first observers to note especially the present-day work of running water and the sea. This last should have given Ray the hint he needed to explain fossil remains; but it did not, and when confronted by the evidence of the rocks, Ray can only admit:

"For my own part (if my opinion be considerable) I think that my learned Friend hath sufficiently proved, that these Fossil-shells were not brought in by any universal Deluge. He hath made it also highly probable, that they might be originally formed in the Places where they are now found by a spermatick Principle, in like manner as he supposes. . . . I shall say no more, but that those who are not satisfied with his Proofs, I wish they would but answer them."

So Ray himself can only add "The following Tables, containing [eighteen drawings of] some Species of the different *Genera* of these bodies, *viz. Shark's Teeth, Wolf-fishe's Teeth, Cockles* or *Concha, Periwinkles* or *Turbens, Coruna Ammonis* or *Serpent-stones, Sea-Virchins* and their *Prickles, Vertebræ* and other Bones of Fishes, *entire Fishes petrified,* . . . for the Information of those who are less acquainted with such Bodies, . . ."

Even so, Ray was on the right track. He was arguing the case on the direct evidence, without appeal to authority. He was watching the seashores and the river bottoms to see what is going on now. He was also the first of men to use "species" and "genera" in their modern sense, and so to pave the way for Linné and the first really clear statement of the Creation Theory. In addition, Ray set forth a notion which was destined to develop into a new set of Flood Theories quite different from anything of his time or earlier.

In Ray's own words, summing up a long discussion:

"If these Stones [*i. e.* fossil sea shells] were found scattered singly and indifferently all the Earth over, there might be indeed some reason to imagine that they were brought in by the Flood; but being found in some particular Places only, either lying thick in great Beds of Sand and Gravel, or amassed together in huge Lumps, by a stony Cement, such beds must in all likelihood have been the Effect of those Animals breeding there for a considerable time: whereas the Flood continued upon the Earth but ten Months and thirteen Days, as I have before shown; and yet there are found these Bodies upon very high Mountains, not excepting the *Apennine* and *Alps* themselves. [If, therefore, these fossils] were the Shells of Fishes, or their Bones, the Water must needs have covered the whole Earth, even the Mountains themselves, for a much longer Time than is consistent with the Scripture History of the Flood, and therefore we must seek some other Original of these Bodies.

"If we stick to the Letter of the Scripture-History of the Creation, that the Creation of Fishes succeeded the Separation of Land and Sea, and that the six Days wherein the World was created, were six Natural Days, and no more; it is very difficult to return a satisfactory Answer to this objection: I shall therefore only add a Conjecture of my own, and that is, That possibly, at the first Creation, the whole Earth was not all at once uncovered, but only those parts whereabout *Adam* and the other Animals were created, and the rest gradually afterwards, perchance not in many Years; during which time these Shell-fish might breed abundantly all the Sea over, the Bottom whereof being elevated and made dry Land, the Beds of Shellfish must necessarily be raised together with it."

Here, then, begins the long process of "reinterpreting" Scripture to make it conform to a growing geology, a process which for a growing astronomy had already completed its cycle and adjusted the letter of Holy Writ to a round and rotating earth. It does not indeed occur to Ray that Archbishop Usher may have been wrong, or that there has been eon upon eon of geologic time in which to get things done. But he has taken the first step toward a naturalistic account of fossils that does not involve Noah's Flood. Even so, it took more than a hundred years to work out the idea.

CHAPTER VIII

ADJUSTING GENESIS TO GEOLOGY

Up to about the beginning of the eighteenth century, the only serious problem as to the past history of the earth arose from doubts as to the nature of fossils. If these were never living creatures, then they have been created in the beginning. If they were once alive, then they testify to the Universal Flood. In neither case is there any question of adjusting Geology and Genesis.

But as the eighteenth century saw open-mouthed wonder at the works of God alter step by step to their detailed study, it gradually transpired that neither the sports-of-nature theory of fossils nor the flood theory will fit the observed facts. Fossils as sports of nature violates common sense. A deluge, by definition, can not sort out its material, land forms here, sea creatures there, brachiopods in this layer, ammonites in this, coal plants in still a third. The flood theory of fossils holds only so long as men pick up queer stones haphazard and put them unassorted in collectors' cabinets. When men come to study fossils out-of-doors, in place in the rocks, then they see that fossils and strata everywhere are precisely what no flood can make.

The flood theory, therefore, undergoes the usual evolution. It begins, as already set forth, with Noah's Deluge accounting for everything except the earth's original crust, which the eighteenth century thought it saw in the older rocks, and especially in the granites. The next step is to take the older stratified rocks—Lower Paleozoic as we should now call them—out of the Flood Year and to shift these back into the 1656 years that separates Creation Week from the onset of the Deluge. This process continues, until about half of geologic time—as then interpreted—has become prediluvian, the Age of Reptiles, speaking broadly, being near the division, and only the Age of Mammals thought of as of Noah's time. Finally, as a last stage, nothing except the loose soil over the hard rocks remains to save Noah's face. Everything else is earlier than his day.

The general idea is, then, that after the first creation and until the Flood, the world went on a good deal as it does now. The rains descend and the winds blow and the spring floods come, washing the soil down into the sea. The sand and mud pile up on the sea floor, layer upon layer. Shells and bones fall to the bottom and are buried up, very much as we now know them to be. The result is a stratified sea floor, with contained fossils that are sorted out layer by layer, because they grew in place. Successive layers differ because conditions change and creatures migrate back and forth.

Then came the Great Flood, with the breaking up of the Fountains of the Great Deep. That meant that the old sea floor rose and became our present dry land, with its stratified rocks and their fossils. The old lands that Shem, Ham, and Japhet knew in their youth sank down and are now ocean. At the end of the Flood, after the rain from heaven was stayed, the dirt settled out of the flood waters, to become the superficial, unconsolidated soil that overlies the hard rocks. Thus everything is accounted for. But the Flood and Noah pass progressively from being the great central fact of geologic history, at the beginning of the eighteenth century, to not much more than a pious opinion at its end.

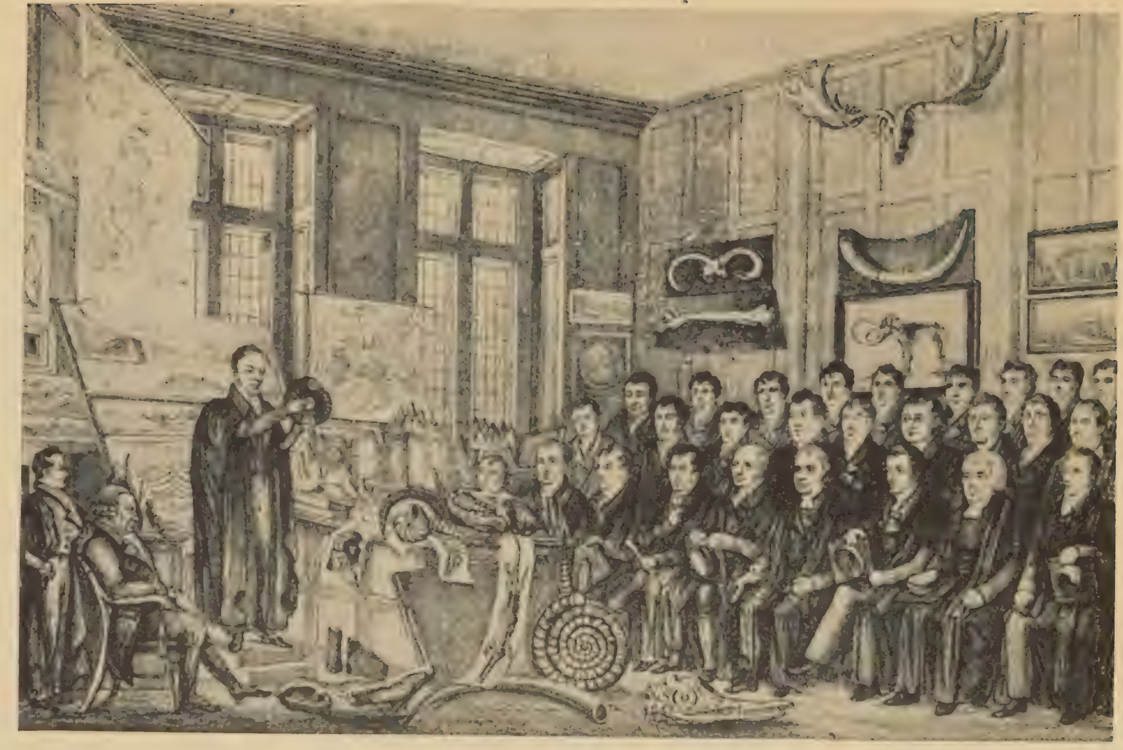
Then, about 1840, came Louis Agassiz and his Glacial Theory that is now the commonplace of our grammar school geographies. According to our present-day opinion, for a good many thousands of years, most of Europe, with North America as far south as New York City and the Ohio River, were so completely snowed under, that they would have offered to the eye, if there had been men to see them, just about the appearance of present-day Greenland or Antarctica under their ice caps. In fact, obviously, we are even yet lingering in the last years of the last great Ice Age.

This theory of Agassiz's "took" promptly with the scientific world, and by 1870 it had become ancient history and unquestioned. It took also with the theological world as geological proof of Noah's Flood.

For the closing stages of the last Ice Age were, indeed, characterized by enormous floods, that resulted in the greatest mass of fresh-water deposits known to geologic history.

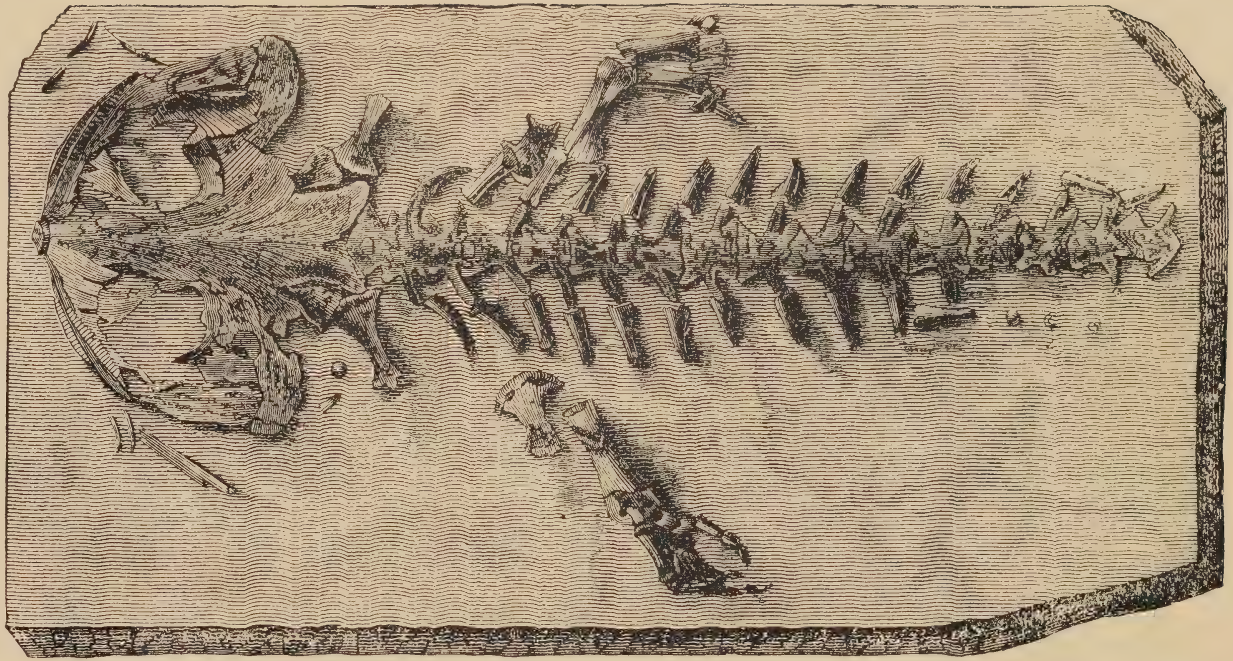
Of the facts concerned, there is no possible doubt. Typical sea and lake beaches, consistently developed, show that toward the end of the Ice Age the water level at Montreal was at least six hundred feet above the present-day St. Lawrence; so that the sea came round by way of the Hudson and Champlain Valleys, backed up all the lesser rivers, and made New England into off-shore islands. If one grants that fossils are genuine remains, there are the obvious sea shells and the bones of at least two whales.

New England is so full of these *reliquiæ diluvianæ* that most of the race-tracks there are on old glacial deltas and half the graveyards on old kames. Over Pittsburgh, the glacial waters stood three hundred feet deep, with twenty thousand square miles of glacial lake filling the Ohio Valley above Cincinnati. Great Salt Lake is now about two thousand square miles in area and twenty to thirty feet deep. It has been a thousand times as large and a thousand feet deep;



William Buckland, DD., F.R.S. (1784–1856) Lecturing on Fossils.

A drawing made in 1822, before Buckland abandoned the Deluge Theory. The lecturer holds an Ammonite, of which another specimen leans against the table and a third is on the table corner. The skull on the floor at the left is apparently an Ichthyosaur; that on the table a carnivorous mammal, probably a Cave Bear. On the wall is the skull and horns of an Irish Elk and a picture of the Siberian Mammoth. All are local fossils.



From *Ancient Life History of the Earth.* HOMO DELUVII TESTIS. Courtesy *D. Appleton & Co.*

The giant newt, *Andrias Scheuchzeri*, discovered at Oeningen in Switzerland and supposed, for about a century, to be the remains of a child, some five feet tall, drowned in the Deluge of Noah.

From an old woodcut of the original specimen still preserved in the Haarlem Museum.

and the old shore-lines, now deserted but plain as the nose on a man's face, still mark, like railway embankments, the sides of the Utah mountains. One need not multiply examples. Every school text-book sets forth the evidence. Europe and Asia are like North America.

Moreover, this washed drift must have formed very rapidly, as time goes in geology; and because this washed drift overlies all other glacial deposits, it must belong to the closing stages of the Ice Age, and be, therefore, about the most recent of all geologic things. What more natural than to identify the end of the Glacial Period with the Great Flood of tradition, Genesis, and the tablets, and make the Biblical account not only true history but important science.

This Glacial Theory of Noah's Flood took shape, through the last quarter of the nineteenth century, chiefly at the hands of Reverend George Frederick Wright, D. D., LL. D., who during his middle years had been assistant on the United States Geological Survey, and was for all his later life Professor of the Harmony of Science and Revelation at Oberlin College. Wright was, in short, the last of a long line of clerical geologists of whom Buckland is the outstanding figure.

The general theory has, naturally, endless variants. In Wright's form, the Flood is local, though involving much of Asia; and the narrative in Genesis is taken to rest on "the log-book of the Ark," the actual day-to-day record of what happened from "the six hundredth year of Noah's life, in the second month, the seventeenth day of the month," to the twenty-seventh day of the same month of the year following, when "Noah went forth, and his sons, and his wife, and his sons' wives with him: every beast, every creeping thing, and every fowl, and whatsoever creepeth upon the earth, after their kinds, went forth out of the ark," just three hundred and seventy days in all—the Babylonian year being three hundred and sixty days.

The weakness of all these theories is in their time-scale. Usher puts the Flood in 2348 B. C., and the best that anybody can do, picking the largest figures of variant texts, will stretch the time only another thousand years. On the other hand, the best anybody can do, paring down to the limit every estimate of geologic time, puts the end of the Ice Age no later than 6000 or 7000 B. C. If one does not cut corners, 20,000 B. C. is low enough for southern Europe and Mesopotamia.

Moreover, within this century, the end of the Ice Age has been dated. Along the coast of Sweden, because the land is rising slowly, it is possible to count the annual layers of the shallow-water sea clays, as one counts the rings of a tree stump; and thus to date post-glacial, or post-deluvial, events in the Baltic region with an error of only about one year to the century. So we know that the ice cleared the north shore of the upper Baltic about 6500 B. C.—which date is taken, a little arbitrarily, as the beginning of "recent" geologic time—and that the southern tip of Scandinavia was free by 11,500 B. C.

But the ice went off slowly, first clearing the lowlands and the south. In fact, the Swiss glaciers and the Greenland ice cap are with us yet. Clearly, no district that Noah saw was flooded at anything like Usher's dates.

This method of time-scaling the 'varve' clays—recent or glacial clays, that is, which show annual layers like the seasonal rings in a tree trunk—has, within the last few years, developed still another weakness in the log-book-of-the-Ark theory. The log of the Ark assigns three hundred and seventy days for the total duration of the Flood, whereas counts of the varve clays show that single ponds, dammed by the ice front and released, lasted a thousand years, and the ice tongue that came down the valley of the Connecticut took four thousand and four hundred years to retreat from Hartford, Connecticut, to St. Johnsbury, Vermont, a scant two hundred miles.

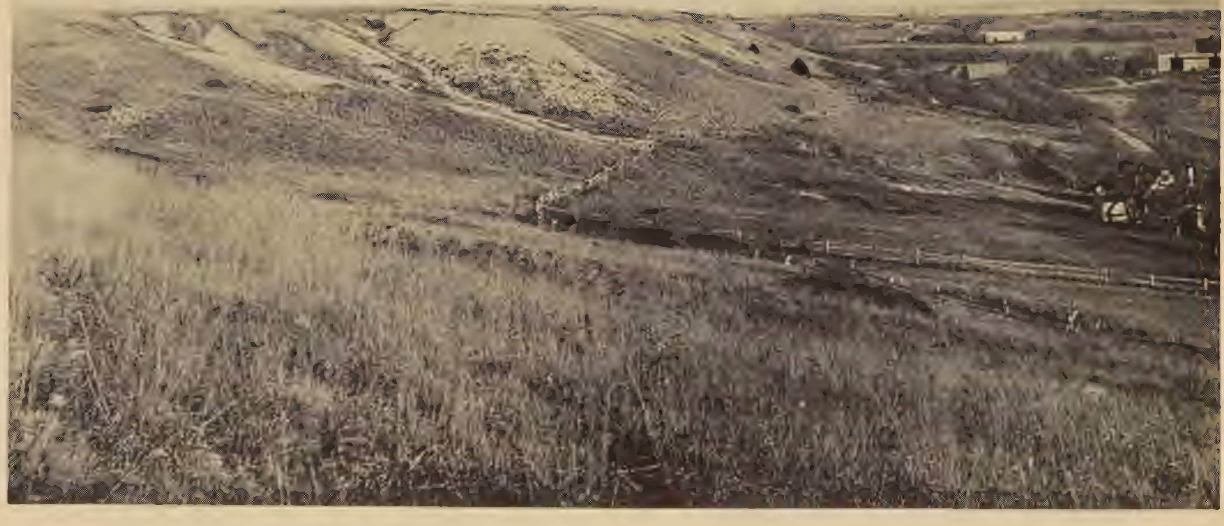
One must not press small points; but there is the obvious alternative. Either Noah's Flood is not the end of the Ice Age; or else Usher's dates are hopelessly unreliable and Usher's whole method of obtaining them quite wrong. Worse than that, the three hundred and seventy days of the log narrative can hardly be stretched out into several thousand years without so much reinterpretation of Biblical language as empties out the baby with the bath. In general, then, since the present century came in, the Glacial Theory of Noah's Flood, though still widely maintained, tends to drop into the background of Creationist discussion.

Its place is now taken, interestingly, by a revival, at the hands of George McCready Price and others, of the abandoned eighteenth century idea which makes the Flood responsible for all the stratified rocks of earth. All stratified rocks, therefore, are of the same date. All fossil animals and plants, wherever found, were alive at once. There is no such thing as geologic time. Noah's Deluge, in short, once more takes its old place as the one chief creative agent that accounts for most of the detail of the present-day world.

One need not add that, nowadays, neither flood theory has any scholarly support.

No more intriguing problem, during the nineteenth century, offered itself to the great science of Biblical exegesis than that of adjusting the Priestly Narrative of Genesis to successive accretions to the facts of paleontology.

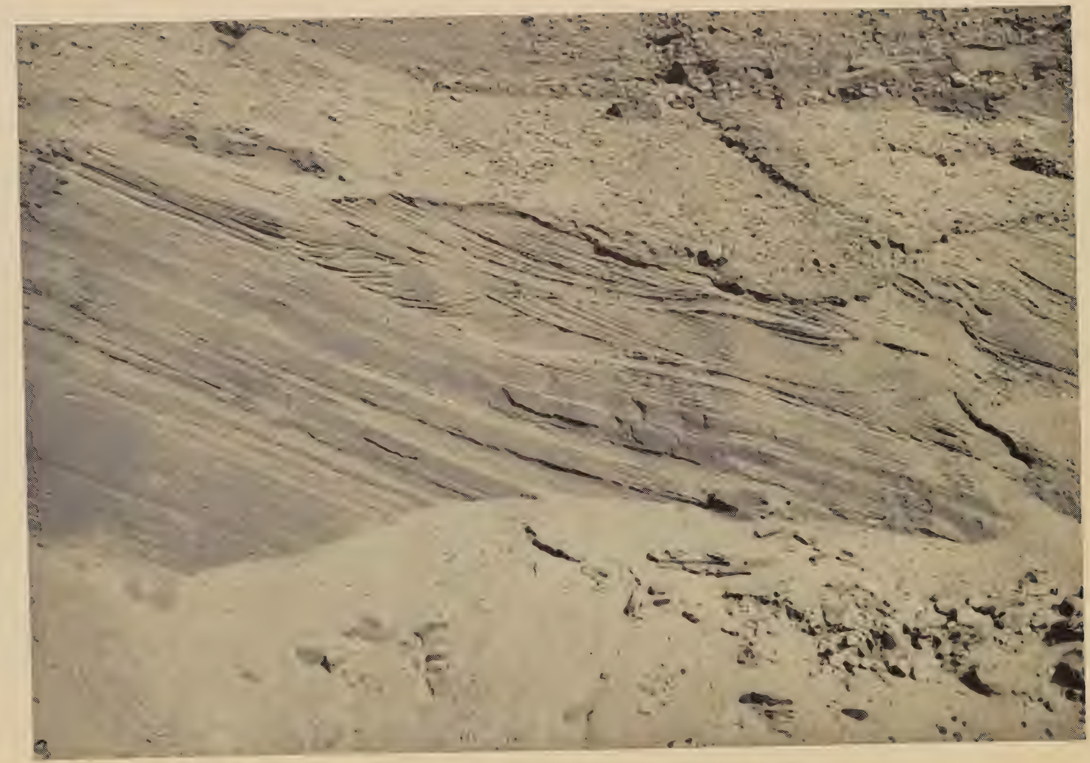
By the beginning of the nineteenth century, geologic time had been proved to be enormously long.



Glacial Delta.

Sand and gravel, evidently deposited by flood water that stood at the level of the flat surface in the middle distance. Interpreted, up to the middle of the last century, as formed during Noah's Deluge.

Harvard University Collection.



Structure of a Glacial Delta.

The variation in the material from gravel to fine sand and the cross-bedding of the sand prove deposition by violent and changing currents. Most of the "Washed Drift" shows these flood conditions.

Harvard University Collection.

Throughout the century, it kept getting longer and longer, as more and more evidence came in. In fact, the process of adding age to eon still goes on; geologic time elongates still farther year by year, and nobody can guess where the process is going to end. Inevitably then, the nineteenth century tended toward that "long chronology" which makes each "day" of the Genesis narrative not merely "as a thousand years," but as something like another thousand times that period. This opinion still obtains widely.

The middle of the century, in addition, saw the order of creation made out in detail. Whether men held that animals and plants are created, or took them to have been evolved, or held no theory about the matter either way, one point was certain: In undisturbed rocks the lowest strata must have been laid down before those on top of them; the fossils deep in the ground are older than those nearer the surface; to go downward into the earth is to go backward into geologic time. On this simple principle rests the whole science of paleontology.

About a hundred years ago, then, the order of creation was known. The problem was to adjust to this known order the text of Genesis 1.

The number of "days" is easily taken care of. There is the continuous story of the world: one breaks it up into six chapters or sixteen or sixty as one likes.

The first half of the Genesis narrative also gives no trouble. Kant and Laplace put forth the old Nebular Theory in the eighteenth century, before there was any real geology of the modern sort and before even the conservation of energy had been thought of. Men were, therefore, fancy free. They could imagine anything they liked for the conditions of an evolving solar system, and fit this to some reading of the Hebrew words.

A highly fanciful rendering of an obscure text matched perfectly the detail of a quite imaginary history of the earth. The agreement proved the truth of revelation. All one can say is that if the solar system ever did evolve from a gaseous nebula, and if our earth ever was a melted and cooling mass, and if a thin rock crust ever did form over a liquid interior, with the essentials of a cosmic Turkish bath in place of the atmosphere that we know, the adjustment to the Biblical account, as read, is not inaccurate. But none of these interesting events has left any sign of itself in the present-day earth, and they all rest on nearly pure speculation without assignable detail of any sort. So the problem of adjusting all this conjecture to the infinitely flexible Genesis narrative takes care of itself.

Not so is it with the problem of the third, the fifth, and the sixth days, when occur the bringing forth by earth and water of the fruit tree yielding fruit after its kind, the sea creatures of various sorts, the fowls of the air, creeping things, and the beasts of the field. The problem is to fit this order to the known appearance of living things on earth from the bottom of the Paleozoic Age up through to the time of the earliest human remains.

That problem has never been solved. Guyot, who was a competent geologist, tried it about the middle of the eighteen hundreds. Dana, of Yale, following him, but with some changes, wrote a *Manual of Geology* that for nearly half a century was the dominant text-book in its subject in American colleges, the one volume that every student with the least pretense of knowledge was assumed to have been through.

The first edition, of 1862, set forth Dana's views: The Biblical account matches so perfectly the record of the rocks that no human insight can account for the duplication. This opinion stood through successive editions of the *Manual* up to that of 1880. Dana is said to have stuck to his guns in private till his death, well toward the end of the century. But his reconciliation of Genesis with geology dropped out of his text-book after 1880. That date, therefore, may conveniently be taken as the last on which any important scientific person reckoned with Hebrew science. Gladstone's disputation with Huxley, of 1885, seems to have ended non-scientific but scholarly attempts to match day against period by details.

The general notion has, nevertheless, a great popular interest even now. Oddly enough, nobody seems yet to have attempted to fit the Genesis story to the Planetesimal Theory. According to this, the earth started small and grew larger, started cold and grew warmer; started without any atmosphere at all and gradually picked one up out of interstellar space—everything, in brief, exactly opposite to whatever is supposed to have happened on the older Nebular Theory. There lies an interesting task for some Biblical exegete.

Serious as contrasted with popular interest inclines nowadays to a quite different reading of Genesis 1 from that which was in fashion in the last century, a reading, curiously, that is said to have the support of no less a man than Doctor Martin Luther.

This exegesis starts with the complete divorce of geologic history from the Biblical account of creation, putting the whole of planetary and cosmic time, from the first beginnings of whatever one happens to think did come first, down to, let us say, the onset of the Ice Age, at the very end of geologic time, into an unmentioned interval between the end of the first sentence of Genesis 1 and the beginning of the second. "In the beginning God created the heaven and the earth."

Then occurred, unmentioned, whatever science has already made out or may hereafter discover. Finally, when in the fullness of time Man was to be created and the world made ready, "the earth became waste and void"—locally. In short, the story of the first day of creation begins only with the third verse of the narrative.

The main idea is not new, many eighteenth century worthies held to some sort of important prediluvian catastrophe, not perhaps unlike the Flood itself, that had preceded the creation of man, accounted for the earlier faulting and folding of the stratified rocks, and is hinted at in "the earth became waste and void." In fact, in the early nineteenth century, the notion expanded to a series of catastrophes, important, disastrous, and world-wide—of which Noah's Deluge was the last—that goes into the Genesis account between the first verse and the third.

Such an exegesis as that of this general theory avoids, naturally, all conflict with any imaginable fact of natural science. Naturally, therefore, it enjoys at the present day a merited repute.

Speaking broadly, then, and ignoring by the dozen inconvenient variants, there have been, historically, two outstanding interpretations of the Creation story and two of the Flood narrative. It is, therefore, only against the background of these, that one can interpret also the further history of the last of the four main problems of Creation Theory—the origin of plant and animal species. From the beginning of the eighteenth century, where our detailed story is to start, up to the end of the last quarter of the nineteenth century, where it is to stop, men as a whole really believed the Bible. Scientific men during that period were freer to speculate than they are now, for fewer facts by far tied them down. But scientific men, in that period, were by no means so free as they are now to theorize. As Huxley put it, about the end of our period, one opened up a promising line of advance. He followed it a little way. Then he came to a sign

NO THOROUGHFARE

MOSES

We do not, then, comprehend the intellectual history of Europe and North America since the Renaissance if we let ourselves forget that for a scientific person to dispute the Bible in sixteen hundred actually did cost one such his life; in seventeen hundred it was likely to cost him his liberty; in eighteen hundred it would ruin his career; and even in this year of grace, there are regions where it affects his bread and butter. In short, for the remainder of this volume, we are to take up the opinions of persons freer than we to speculate in the face of evidence, less free than we are now to theorize in the face of texts.

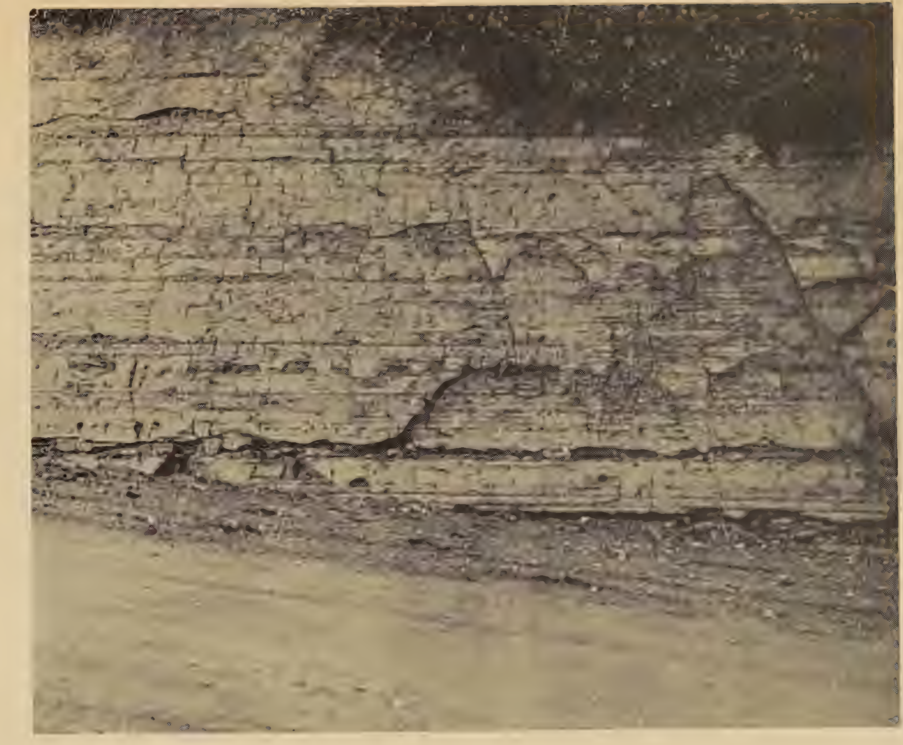
For the most part, up to and beyond 1850, when people say "create," they mean to bring to being in some kind of six days: when they run back the history of any creature, they consider what befell it during the Great Flood.

If at this point one turns back for the moment to review the general course of the history of three of the four main problems which every Creation Theory must attempt to solve, and neglecting detail, tries for the general outline only, one can hardly fail to be struck with the cyclical character of successive phases of opinion. The early Church, for example, essentially Neo-Platonist or Gnostic in all its thinking, takes Genesis 1 in a "pneumatical" sense. It has no interest in the scientific problem. It does not think of "Moses" as even trying to tell any story of what actually occurred. All detail of days and greater lights and creeping things vanish into a fog of allegory. Finally, civilization itself slowly runs down, and Greek science is submerged in the Ages of Faith.

When, after the Renaissance, Greek science comes back and the past history of the earth is gradually recovered, there develop, especially through the eighteenth century, various Systems of the Earth that try to adjust the text of Genesis to the facts of geological knowledge. These adjustments become more and more detailed as information grows, until they culminate, in the first half of the nineteenth century, in very precise matchings of period against "day." Then the tide turns. As geologic fact becomes more and more certain, Biblical renderings become more and more vague. Before the end of the century, the last scholarly attempt at adjustment has failed. The world has returned to a "poetic" rendering of Genesis that differs practically not at all from the "pneumatical" rendering of the early Church.

So is it also with the story of Noah's Flood. Pre-scientific man marvels at the miracle. But pre-scientific man has no interest in the rocks of earth, and it does not occur to him to use the Great Deluge to account for anything that he can see. Slowly, however, as men come to concern themselves with the things of this world and to notice what is under their eyes, the Flood becomes a geologic agent. It becomes the one great agent in creating the present-day world just as soon as strata are recognized as water-deposited sediments and fossils as real remains.

Then, once more, the cycle reverses. First the earlier rock layers are shifted back to antideluvian days; then the great mass of the known rocks; then everything except the washed drift of the late Pleistocene. Finally, everything goes. There is nothing anywhere on earth to evidence the Biblical Deluge. We are back where we started from, with a Flood that

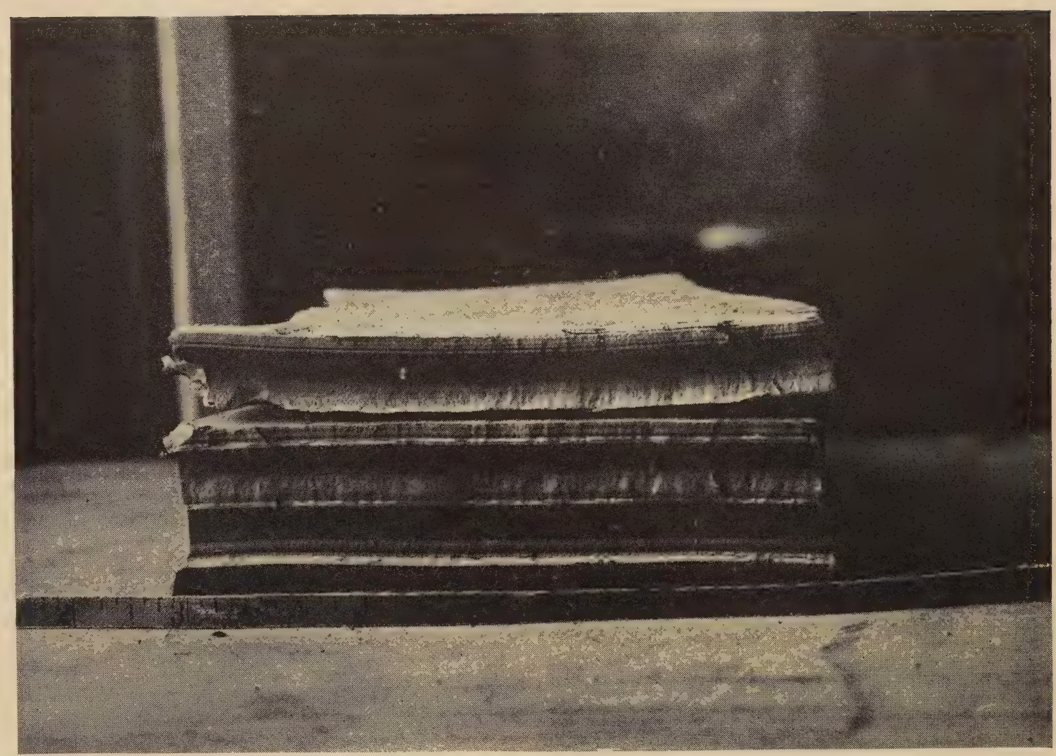


Annual Layers in Glacial Clay.

Connecticut River.

Counts of such annual layers, brought down through post-glacial deposits and linked with counts of the annual growth-rings of old trees and other historical evidence, now carry fixed dates back to B.C. 11,500.

Courtesy of Robert W. Sayles, Harvard University Museum.



THREE ANNUAL LAYERS OF A VARVE CLAY.

Woodsville, New Hampshire.

The solid ''fat'' clay is deposited during the winter. The more changeable conditions of summer give the fine bands of alternating silt and clay as the weather alters week by week.

Courtesy of *Robert W. Sayles, Harvard University Museum.*

explains no fact with which the student of the earth is concerned.

Creation Week of the Genesis account matched against geologic time repeats the same story. Augustine, always fundamentally pre-Christian, clings to the Mithraic concept of unending time, and quite ignores all idea of any dated origin for the universe or its parts. That idea holds, at least in southern Europe, down into the period of the Schoolmen. Time is a small matter, and the world is very old.

Then comes the Protestant Reformation. But the Protestant Reformation is basally not Mediterranean but Baltic, Gothic and not Greek. Therefore do Protestants, as does not the Roman Church, forget the pit out of which European civilization was digged, and set Hebrew authority above Latin. Probably many times more Protestant theologians than Romanist of the same dates have believed in a flat earth.

But after the Reformation, Baltic opinion strongly influenced Mediterranean. Among other things, the Bible, in Roman Catholic lands, took on an authority that it did not have before, and Genesis 1 taken as read supersedes earlier renderings of Augustine and Aquinas. Thus, for example, the great Jesuit theologian, Francisco Suarez, who died in 1617, though in a sense the last of the Schoolmen, breaks completely with the Aristotelian tradition, and quite flatly disputes both St. Augustine and St. Thomas. For Father Saurez, as for Archbishop Usher, the Six Days are to be taken literally. Would God, he demanded, inspire Moses to "use language, the true meaning of which is hard to discover, and still harder to believe?" From the rise of Protestantism, in short, for both branches of the Western Church, dates the problem of adjusting the length of Creation Week to the duration of geologic time.

Once more the cycle. The unlimited, though vague, time of pre-Reformation opinion first contracts to precisely twelve times of the hour hand round the clock dial. Then it expands, slowly, as the geologists insist on longer and longer epochs to get in the known detail of the rock column. In this year of grace, among theologians, only a minute fraction even of extreme Fundamentalists cling to the literal six days. The rest of the world has gone back to Augustine and Aristotle.

In short, for these three problems, the length of geologic time, the order of creation, and the efficiency of the Deluge, as saith the Preacher, "The wind goeth toward the south, and turneth about into the north; it turneth about continually in its course, and the wind returneth again to its circuits. . . . That which hath been is that which shall be; and that which hath been done is that which shall be done: and there is no new thing under the sun. Is there a thing whereof men shall say, See, this is new? it hath been already, in the ages which were before us." For all practical ends, for all clearing up of important ideas concerning three out of the four problems of creation, all the disputation and all the heartburning and all the manifold reiteration of truth and nonsense between Augustine's commentary on Genesis of the fifth century and Gladstone's essays on the same topic of the nineteenth, was so much good ink and paper thrown away. Europe, at the end, came out by the same door wherein it went.

CHAPTER IX

PRE-FORMATION AND THE LADDER OF LIFE

THERE remains the fourth of the main problems of creation, the origin of species. After all is said, the living animals and plants on the earth's surface are more interesting to most of us than either the lifeless rocks that make its crust or the heavenly bodies that appear to circle round it. Moreover, for historical reasons, the origin of present-day organic species, whether by evolution or by direct creation, has always been the main point of difference between two schools of thought. In addition, the history of the successive theories of the origin of living things, as these theories have come and gone, unlike the history of the three other problems, has not been cyclic but linear. The story has gone forward. Opinion, advancing somewhat steadily, has arrived somewhere.

For the history of this opinion, one must consider first of all its background. Until about 1650, when Redi and Harvey, on experimental grounds, began to call in question the dictum of Aristotle concerning spontaneous generation, it was impossible that any real problem should arise concerning the origin of species. In the beginning, of course, as the Bible declares, God created animals and plants. But at any time thereafter up to now, the earth and the waters, of themselves, brought forth more. Why trouble to inquire which is which? There is no particular difference anyway.

But with spontaneous generation fairly disproved for certain alleged cases and rendered highly questionable for most others, the problem of the origin of actual animals and plants must somehow be met. There, on the one hand, is the Bible, infallible, indeed, but by no means easy to interpret with the little that remained of Hebrew scholarship after fifteen centuries of skilful persecution of the Jews. On the other hand, there are the living animals and plants of western Europe, with rumors concerning other portions of the earth, together with some vague ideas concerning fossil creatures also—altogether a considerable body of information, though none of it really sifted out fact from fiction. The challenge came inevitably to adjust the two.

Meanwhile there had been going on one of the great revolutions in the mental history of our race—the rise of observational knowledge in modern Europe and the concomitant revolt against the authority of Aristotle. Francis Bacon, who died in 1626, is often credited with leading both. The fact is, however, that Bacon only recorded, cleverly, that which had already occurred.

Bacon's own "inductive method" has turned out in practise to be quite unworkable, so that neither Bacon himself nor anybody else after him ever discovered anything at all important by means of it, and its author, as Harvey said, "wrote about science like a Lord Chancellor."

Whatever the causes may have been, our world did somehow break with its past by substituting for Aristotle's authority, Aristotle's method; with the result that between the time of St. Thomas Aquinas and that of "St. David" Hume, men changed from asking, What has Aristotle said? to doing as Aristotle did—namely, to going out into the face of nature and digging for the facts. In that period, slowly to be sure, present-day science was born, or Greek science was reborn, whichever way one chooses to view the occurrence.

Meanwhile, chiefly as the result of the Protestant Reformation, the Bible had been promoted to that position of scientific infallibility from which Aristotle was being deposed. Seers and priests out of one of the least scientific peoples of the ancient world became final authority on all that concerns nature, in place of the highly competent Greek naturalists and their disciples, the Arabians.

In brief, then, taking somewhat arbitrarily the year 1600 as a convenient starting point, we have to note, for the century or more which follows, the change in Europe from Aristotle to the Bible as final authority concerning the origin of species, the rise of the whole scientific problem of animal and plant modification and descent which followed the collapse of spontaneous generation, and the shift of nearly universal opinion from an easy-going, Greekish, rather vague Evolutionism, to an Hebraic and rigid Creationism.

Unfortunately, in dealing with the history of ideas, one can not take events in strict chronological order, as in political history one takes coronations and battles. Ideas overlap. One great man, looking ahead, catches sight of what is to come into general fashion in the next generation. Another, equally great, clings to the past a generation after other men have changed their minds. Each, moreover, may hold advanced opinions on some matters, and retrograde opinions on some others. Science never quite holds its whole line steady in company front.

Let us, then, for logical convenience, take our chronological bull by the horns, and jump from Redi and Harvey early in the sixteen hundreds, clean across a period in which certain ideas were taking shape in northwestern Europe, to the time when these ideas had reached their complete formulation at the hands of Charles Bonnet, who was born in Geneva in 1720 and died in 1793.

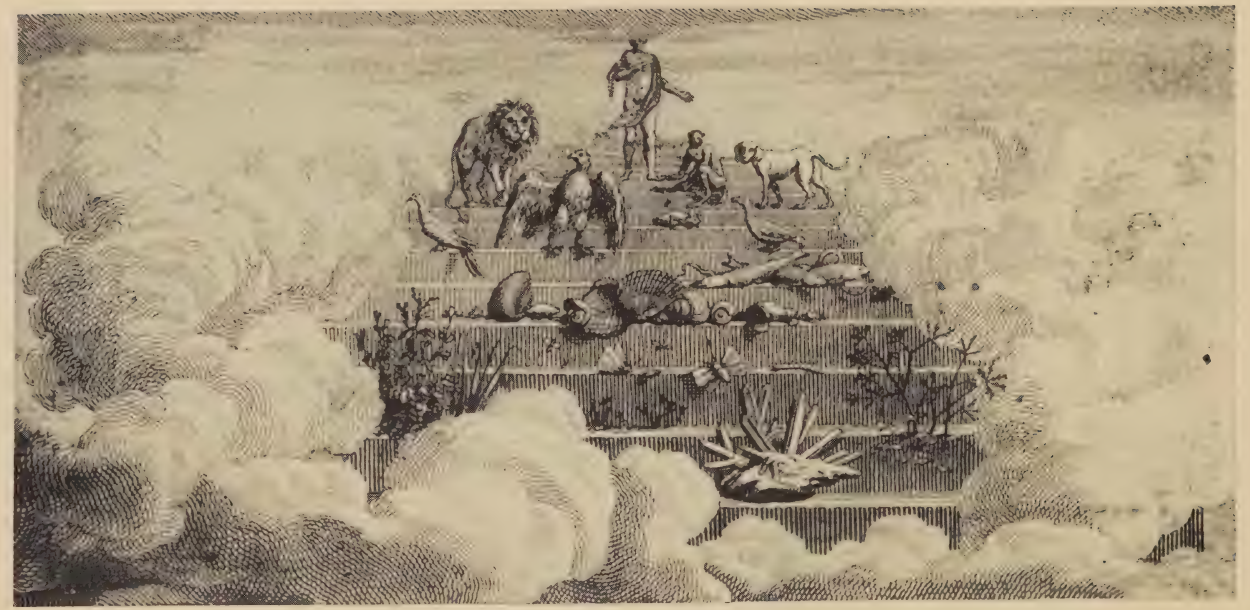
Bonnet was a leading naturalist of his time, and still is an important figure in the history of natural science. He was member of Imperial, Royal, or learned Academies of Russia, Germany, England, Bavaria, and Sweden, coworker with Réaumur at the University of Geneva, the subject of attack by Erasmus Darwin and support by Cuvier, founder of a whole school of embryologists, discoverer of the mechanism of respiration in insects and of parthenogenesis in bees and plant lice—"vine-fretters" is the contemporary English rendering of his name for the latter—and above all, for present purposes, the man who first employed the term "evolution" in any natural history sense.

Bonnet was, then, no closet naturalist. On the contrary, he ruined his eyes over his minute observations; and as a result, like Weismann in our own time, turned to theorizing when, after 1754, he could no longer clearly see. In particular, he took issue with Harvey, who in turn followed Aristotle, over the question whether the young animal as it develops in the egg, has or has not all of its parts already pre-formed in the germ.

Harvey maintained that it has not. Harvey, working mostly on the chick, thought he saw one organ after another, heart and lungs, limbs and feathers, gradually take shape out of an amorphous jelly in

CHARLES BONNET
né à Genève le 13 Mars 1720

Charles Bonnet, Who Invented "Evolution" (1720–1793).
Frontispiece of the eighteen-volume Neuchâtel edition of 1779.



THE LADDER OF BEING.

This *échelle des êtres* ascends from "*matières plus subtiles*" at the bottom, by way of Fire, Air, Water, and Earth, through Metals, to Quadrupeds, Monkeys, Orang-Outang, and Man.

From *Oeuvres D'Histoire Naturelle et de Philosophie de Charles Bonnet*, volume 4, page 3, of the ten-volume Neuchâtel edition, 1781.

which there are no parts. Bonnet, admitting all that Harvey saw, argued nevertheless on theoretic grounds that behind the growing, visible organ lies the invisible *anlage*, part for part, that only grows to visibility and use. Nothing, in short, forms in the embryo. All that happens is that something already there alters size and shape.

Bonnet has sometimes, most unjustly, been held to suppose that the invisible chick, ultramicroscopic in the germ, has any chick-like appearance. But Bonnet himself is careful to explain that the parts of his germ need not at all resemble the organs which they are to become. All he maintains is that each, from the beginning, is present in some form, independent of all the rest. Thus does Bonnet as early as 1764, anticipate surprisingly our current doctrine of the chromosomes as the vehicles of hereditary qualities, even to the hypothetical "genes" that these chromosomes contain. Nevertheless, on the whole, Harvey proves to be nearer right and the organs of an embryo do take shape out of a protoplasm that is apparently homogeneous.

Harvey's doctrine is known as "epigenesis," that is to say, the genesis "upon" the embryo of organs that were not there before. Bonnet's is commonly called, obviously enough, "pre-formation." But Bonnet himself, playing up the idea of the "rolling out" of the pre-formed organs, called his process *"evolution,"* using italic as for a foreign word. This seems to be the first employment of "evolution" in any branch of natural history. As late as 1860—practically the year of Darwin's *Origin*—Chamber's Encyclopedia knows no other senses than this embryological one, the rolling out of mathematical curves, and the evolution of troops in the field and fleets at sea. So, too, is it with even the later editions of Johnson's *Dictionary*. Evolution in our current sense is, then, decidedly modern. Not even yet has it made its way into French.

Obviously, however, if, as Bonnet held, a preformed germ merely "evolves," this "evolution" becomes identical with creation. The question then becomes, When does this creation occur?

Bonnet meets the query unflinchingly. If there is no epigenesis but only evolution, then there is no such thing as generation either. All creatures that ever were, or are now, or ever shall be to the end of time, must have been created at the beginning by the direct act of God, as germs. As germs they remain, century after century, age after age, until in what is for each the fullness of time, their process of evolution begins, and the resting germ rolls out into the visible animal or plant. There is, then, no such thing as the propagation of one generation by the next older. There are no old creatures and no young. All things date from the beginning if they are alive at all. Thus, by a strange irony, "evolution" originally meant the most extreme imaginable form of Creationism!

As to where these primeval germs remained through sundry millennia to await their evolution, was a point on which opinions differed. A not unplausible theory supposed them to pervade all substances, especially perhaps the air, and from time to time to fall into such situations as made possible their development. Thus an invisible and atmospheric germ that contained a sub-miscroscopic plum tree might be wafted by the breeze to a plum blossom, and as a natural result, evolve first to a seed in that blossom and then in the earth to another tree. Likewise, we may well suppose that, as in the immemorial "spirit theory" of generation, which some simple-minded savages still hold, the germ gets into a woman's food and is swallowed, makes entry by way of bath-water or falling leaf, and becomes a child. In addition, on this germ theory, fossils are but the aborted evolutions of germs that have fallen by the wayside, and got into cracks in rocks. John Ray, it will be recalled, about 1700, inclined on the whole to prefer this general notion to the flood theory of fossils.

Bonnet's theory is consistent and ingenious. Bonnet himself, however, points out that if a peach is enough like a pear so that either may be grafted on the other's root, the two should also be enough alike so that an invisible plum germ out of the air will connect with a peach tree and evolve in that environment. This theory of "dissemination," as it came to be called, Bonnet examines with large knowledge and acutely, and finally inclines to reject in favor of the alternative theory of "*emboitement*," or in that day's English, "jointing."

Consider, reasoned no small part of the learned world, from before 1700 to some years after 1800, the case of the domestic fowl. The female chick, newly hatched, has all the eggs that she will ever lay already formed within her body. They grow successively and are laid. But when the first supply is gone she lays no more. The hen does not form the egg. The egg is present already when the hen herself was inside the shell. Just this is, in fact, true within the limits of microscopical technique in 1800.

Go back then to the Creation. The first hen had all her chicks inside her when she came first from the Creator's hand. Therefore was the second generation of hens created simultaneously with the first. The facts are correct, and there is no escaping the logic. Then it follows, at least as a perfectly reasonable theory, that the third generation of fowls was also created at the beginning, inside the ovarian eggs of the second generation. Whence it appears, logic being logic, that the first fowls of the air, and likewise, naturally, every female of every species, was created in the beginning with all the germs inside her that will ever appear as living animals on the earth to the end of time.

If it is objected to this somewhat startling notion, that one finds it a little difficult to visualize clearly our mother Eve molded out of Adam's rib with all the daughters of men that shall ever live already present in her ovaries, reply is made at once that a small bit of musk will perfume a room for years without losing weight, and that Boyle, "the Father of Chemistry and brother of the Earl of Cork," has set forth in his *Discourse concerning the strange Subtilty of Effluviums,* that "filed Copper" dissolved in "Spirit of Salt Armoniack"—from which, apparently, results a blue salt of cuprammonium—will color visibly a quarter of a million times its weight of clear water; that a dog will follow the scent of a deer a day after the animal has walked through the woods—that, in short, there is no limit to the smallness of particles which nevertheless have all their specific qualities, and that God can make anything minute enough to go inside anything else.

Furthermore, the common interpretation of Bonnet's theory of *emboîtement* that locates the series of germs one inside another like a nest of Chinese boxes, really does no small violence to his words. His actual text fits quite as well the mental picture of germs of the same size, like a string of beads in a box, of which one only, in each generation, evolves into another box to hold the rest. So after all, Bonnet's general doctrine is not so very different from our modern continuity of the germ-plasm, except that the germ-plasm is seen visibly to grow in amount, while Bonnet's germs are fixed in number from the beginning. But our whole modern concept of individual—even separable—hereditary units for each "unit character" is just as hard to visualize as Bonnet's "jointing" of original germs. As Bonnet said in 1764, "Nature works as much in miniature as she pleases, and the last terms of the division of matter are known to us."

Here, then, as after a century of discussion and controversy it culminated in Bonnet's *emboîtement,* is the first form of a really scientific Creation Theory. As Creationism, it is, of course, absolute. Not only is there no spontaneous generation of animals and plants now from any non-living matter, there is not even any generation of living offspring by living parents. All that is at all, down to each least part, is utterly ready made, created once for all, and never altered forever after, except in size. Moreover, the female of the species is the important thing, for she carries about and preserves those original germs, minute beyond all imagining, which are, essentially, all that is in the organic world. The male but stimulates to its evolution the simulacrum that has been resting since that first day. However, in Bonnet's theory, the "fecundating liquor" does affect the relative final sizes and shapes of the evolved created parts, so that even mules are accounted for. But ultimately, what really counts is the created germ; and there is, strictly speaking, no such thing as either reproduction or heredity.

Still another important idea follows logically from this extreme Creationism. If there is no descent from parent to offspring, if all living things that will ever be are created at once as individuals, then the word "species" has no meaning in nature. Species, indeed, there are, but only as a mnemonic convenience. No creature is really related to any other, each creation is unique, and as Bonnet puts it, "the distributions we make . . . are purely nominal, and we should consider them as mean relatives to our difficulties and the bounds of our knowledge. Those intelligences which are superior to us, discover perhaps more varieties between two individuals which we range under the same species, than we do between two individuals of distant genera." ". . . these intelligences," he continues, "see, in the scale of our world, as many steps as there are individuals." A species, in short, for Bonnet is an artificial, not a natural group.

Here again, Bonnet anticipates the next century.

The species as a human invention, only the individual as real, is precisely Darwin's view, which he maintained against the Creationists of his day. This is, of course, also present-day scientific opinion.

With only individuals real and created, it was natural, though not inevitable, that Bonnet and his followers, like those before him whose minds worked the same way, should take up with an old idea of Aristotle's concerning the "*échelle des êtres*" or Ladder of Being.

Aristotle, not to go too far afield, never knew quite enough anatomy more than to glimpse our present-day views as to the relations among various sorts of living things. For him, animals for their part, and plants for theirs, make a linear series from simple to complex, not the branching genealogical tree with which the present day is familiar. One starts with the simplest polyp and marches straight through to man: there are no side lines. This opinion of Aristotle prevailed universally in Europe down to about 1800.

After 1700, this general notion of the linear succession of all things was powerfully reinforced by Leibnitz's Doctrine of Continuity. Leibnitz's philosophical system is, indeed, somewhat flashy; but it dominated European culture from Leibnitz's own time —he died in 1716—up to the time of Kant, whose

Critique of the Pure Reason is of 1781. Leibnitz's famous *monads* really are not altogether unlike Bonnet's germs, original and unique creations, unrelated and unaffecting one another. In addition, after the Aristotelian manner, in Leibnitz's words, "All natural orders of beings present but a single chain, in which the different classes of animals, like so many links, are so closely united that it is not possible either by observation or imagination to determine where one ends or begins." *"Natura,"* aphoristically, *"non facit saltum."*

Bonnet, in his *Contemplations de la Nature* of 1764, develops the same idea at some length, with all the wealth of details that befits a thoroughly competent naturalist. All things that are, Bonnet insists, form literally a scale, "and all compose but one single consequence, which has for its first term an atom, and for its last the most exalted cherubim."

"Between the lowest and highest degree of corporeal or spiritual perfection," to follow an English version of the *Contemplations* of 1766, "there is an almost infinite number of intermediate degrees. The result of these degrees composes the *universal chain.* This unites all beings, connects all worlds, comprehends all the spheres. One sole Being is out of this chain, and that is He that made it."

As for animals in particular, "Animals with shells bear an affinity to fishes. *Reptiles* seem to take place between or next to them, being united in some measure to shell'd animals by the *slug,* and to fishes by the *water-serpent.* . . . The *eel* by its formation, and *creeping fishes* by their method of moving, seem to connect fishes with the water-serpent."

"I see the flying-fish dart itself into the air from the bottom of the water, having fins resembling the wings of a bat. Therein, I think, it has an affinity to birds.

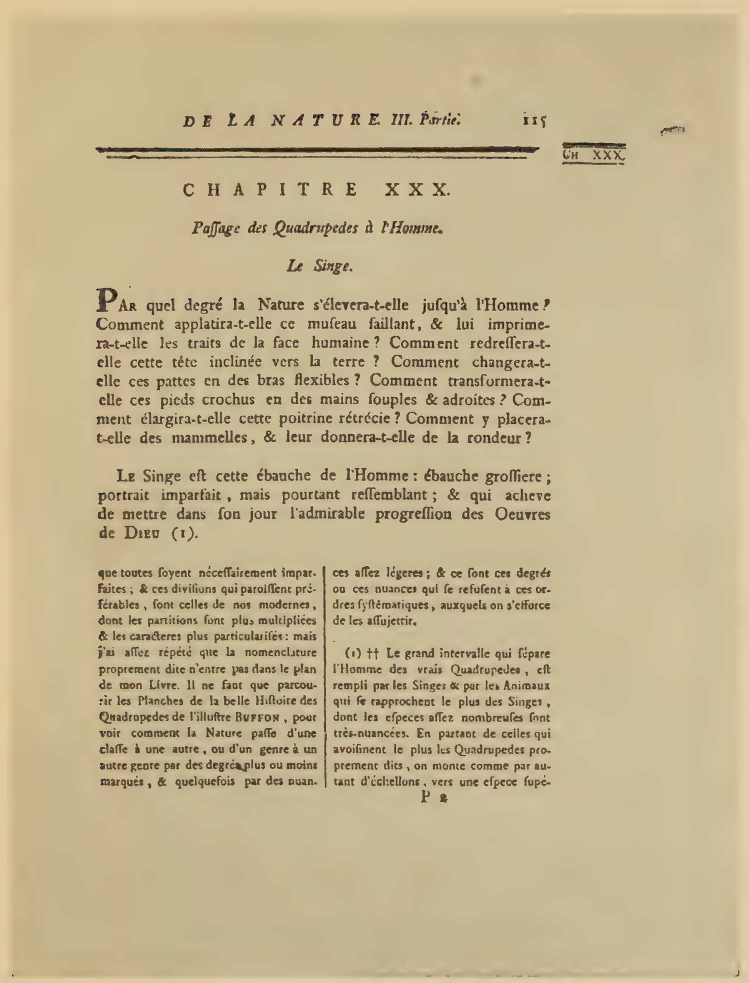
"But I see a great animal advancing toward the sea-shore, having a head and fore-part like a lion, and the hind part resembling that of a fish. It has no scales; and it is borne on two paws that have toes with fins to them. 'Tis called the *sea-lion.*

"He is followed by the *sea-calf,* and the *hippopotamus* or sea-horse, and by all in general of the *cetaceous* kind.

"The *crocodile* and *tortoise* present themselves to my view in their turn; and I now find myself among quadrupeds.

"Without presuming to account for the ways of nature, we will at present place birds between fishes and four-footed animals. . . . In this order *aquatic* birds are ranged immediately under the flying-fish."

So it goes, page after page of the *Contemplations.* "The *bat* and the *flying-squirrel* are these strange animals, which are so proper for establishing the grada-



CH XXX.

CHAPITRE XXX.

Paſſage des Quadrupedes à l'Homme.

Le Singe.

PAR quel degré la Nature s'élevera-t-elle juſqu'à l'Homme? Comment applatira-t-elle ce muſeau ſaillant, & lui imprimera-t-elle les traits de la face humaine? Comment redreſſera-t-elle cette tête inclinée vers la terre? Comment changera-t-elle ces pattes en des bras flexibles? Comment transformera-t-elle ces pieds crochus en des mains ſouples & adroites? Comment élargira-t-elle cette poitrine rétrécie? Comment y placera-t-elle des mammelles, & leur donnera-t-elle de la rondeur?

LE Singe eſt cette ébauche de l'Homme: ébauche groſſiere; portrait imparfait, mais pourtant reſſemblant; & qui acheve de mettre dans ſon jour l'admirable progreſſion des Oeuvres de DIEU (1).

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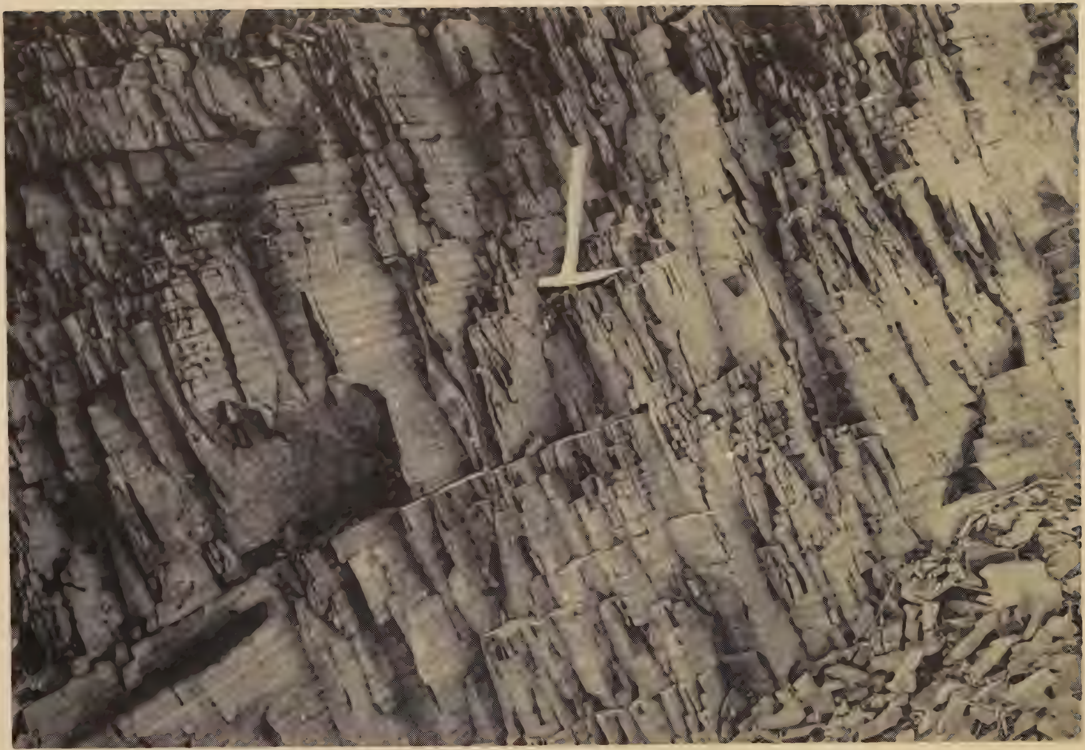
que toutes ſoyent néceſſairement imparfaites; & ces diviſions qui paroiſſent préférables, ſont celles de nos modernes, dont les partitions ſont plus multipliées & les caracteres plus particulariſés: mais j'ai aſſez répété que la nomenclature proprement dite n'entre pas dans le plan de mon Livre. Il ne faut que parcourir les Planches de la belle Hiſtoire des Quadrupedes de l'illuſtre BUFFON, pour voir comment la Nature paſſe d'une claſſe à une autre, ou d'un genre à un autre genre par des degrés plus ou moins marqués, & quelquefois par des nuances aſſez légeres; & ce ſont ces degrés ou ces nuances qui ſe refuſent à ces ordres ſyſtématiques, auxquels on s'efforce de les aſſujettir.

(1) †† Le grand intervalle qui ſépare l'Homme des vrais Quadrupedes, eſt rempli par les Singes & par les Animaux qui ſe rapprochent le plus des Singes, dont les eſpeces aſſez nombreuſes ſont très-nuancées. En partant de celles qui avoiſinent le plus les Quadrupedes proprement dits, on monte comme par autant d'échellons, vers une eſpece ſupé-

P 2

One of the passages from Bonnet's *Contemplation of Nature* which Wesley included in his *Survey*. This is the most important of the quotations from Wesley which are taken to prove his belief in Evolution. Translated near the end of Chapter IX.

From Neuchâtel edition in 10 vols. of Bonnet's complete works, volume 4, 1781.



ANNUAL LAYERS IN A LATE PALEOZOIC SLATE.

Squantum, Massachusetts.

This deposit, originally the clay on a lake bottom, was laid down during a glacial age which followed the Coal Period. By counting such annual layers, time intervals in geologic history are now determined with an error of only one per cent.

Courtesy of *Robert W. Sayles, Harvard University Museum.*

tion that subsists between all the productions of nature." For bats are "hairy birds, having projecting ears, a mouth furnished with teeth, and whose body is carried on four paws armed with claws. . . ." "The ostrich, with the feet of a goat, which rather runs than flies, seems to be another link which unites birds to quadrupeds."

Bonnet, in short, like other men of his day, has no anatomical background for his ideas. If things look alike or act alike, then they are at least enough alike to be links in his unbroken Chain of Being from atom to archangel. Some of his contemporaries even went so far as to suggest that fossils, never, of course, the remains of any living creatures, are a sort of "filler," diagrammatic outline of something that might have been, sketched in by the Almighty to complete the ideal scheme and make the Ladder of Life absolutely continuous. In any case, in Bonnet's words, "God commands the universe to be: the universe is instantly produced," everything in it, past and present, living and dead and to be born, of precisely the same age, and all creation an unbroken chain.

It is by way of this Ladder of Life that John Wesley is most commonly dragged into the Evolutionist camp. Wesley, one must not forget, was a scholar. He taught Greek at Oxford before he went on the road, he handled French and German at least comfortably, he read wisely and enormously, and he had all his life an uncommon interest in most branches of natural science. For most of his working days, moreover, he faced a peculiar problem, that of training up a body of preachers of sound opinions and adequate information out of able but unlettered disciples—for the usual channels of ministerial education simply did not come near to supplying his demand. No small part, then, of the extraordinary labors of his long life went into teaching; and to this end, he translated or abridged various learned works of contemporary scholars to aid the studies of ambitious young men fitting for the Methodist ministry, or combined portions of such volumes with his own ideas.

Among other essays of this sort, Wesley brought out a somewhat formidable work entitled

A SURVEY OF THE WISDOM OF GOD IN THE CREATION
or
A Compendium of Natural Philosophy
containing
An Abridgment of that Beautiful Work
The Contemplation of Nature
By Mr. Bonnet of Geneva
Also
An extract from Mr. Deuten's Inquiry into the Origin of the
"Discoveries Attributed to the Ancients."

One did this sort of thing in the days before copyright; and Wesley, following custom, took over bodily some hundred and fifty pages of Bonnet, including pretty much the whole group of sections that deal with the Ladder of Life. Later, during the nineteenth century, these opinions having gone out of fashion, the translations from Bonnet disappeared from Wesley's text. But the third American edition, of 1823, by N. Bangs and T. Mason of New York, has Bonnet word for word in the proof-texts for Wesley as an Evolutionist.

Take in particular this passage, oft-quoted and commonly taken as full evidence of Wesley's Evolutionism. The text is from Bonnet's unnamed English translator of 1766 but this is so nearly identical with Wesley's own *Survey* that the latter probably rests more on the English translation than on the French original.

"CHAP. XXX

"Passage from quadrupeds to man.

"The ape.

"BY what degrees does nature raise herself up to man?

"How will she rectify this head that is always inclined toward the earth? How change these paws into flexible arms? What method will she make use of to transform these crooked feet into supple and skilful hands? Or how will she widen and extend this contracted stomach? In what manner will she there place the breasts, and give them a roundness suitable to them?

"The ape is this rough draft of man; this rude sketch; an imperfect representation, which nevertheless bears a resemblance to him, and is the last creature that serves to display the admirable progression of the works of God!"

All this, and a great deal more like it, taken over by Wesley out of Bonnet, does indeed sound like evolution. But it is not. It really is the *échelle des êtres*. Put back into its context, the passage says no more than that in the Scale of Being, the ape, so to say, carries over the pattern from the lower quadrupeds to man, precisely as bat and flying-squirrel and ostrich link quadruped to bird. There is no least hint anywhere in Bonnet's pages of any descent of one creature from another, or even of any time sequence in the creation. Everything is created at once, and nothing alters thereafter. On that point Bonnet is absolutely clear.

But Wesley quite obviously agrees with Bonnet. So the only basis for the wide-spread opinion that Wesley accepted organic evolution is Wesley's obsession with the Ladder of Life and the confusing circumstance that Bonnet himself called by the name

Evolution the most thoroughgoing and uncompromised of all non-evolutionary systems. Of Evolution in our present-day sense, it is most improbable that John Wesley had so much as heard!

CHAPTER X

LINNÆUS AND THE DEFINITION OF SPECIES

GIVEN the initial form of a scientific Creation Theory as it took shape during the eighteenth century and culminated in Bonnet, it must be clear enough that there are several sides from which the general scheme may be attacked and broken down. If, for example, the improvement of embryological technique makes it possible to see directly just what does happen inside all ordinary eggs, it may turn out that the embryos in them are visibly not pre-formed, and therefore can not possibly "evolve." Just this did indeed occur at the hands of a series of gifted and diligent students of embryology not far from the middle of the nineteenth century. We now know, by direct observation, that neither pre-formation nor evolution in Bonnet's sense occurs anywhere.

In addition, this whole Aristotle-Bonnet-Wesley idea of a Scale of Being is inevitably doomed by the arrival of a scientific Comparative Anatomy; for the reason that, just as soon as men really know in detail what is inside animals and plants, they see at once that they can not possibly be arranged in any linear series. Comparative Anatomy in its modern form dates from the early nineteenth century. Our initial Creation Theory, therefore, escaped the criticism of the middle of the century, only by collapsing under the criticism of its beginning.

Meanwhile, throughout the eighteenth century, there had been developing a set of opinions concerning the nature of species that also is fatal to the whole idea of an initial creation of independent and self-existent germs. Therefore, as we shall discover in detail, the history of general Creation Theory in the eighteenth and nineteenth centuries is the story of successive adjustments of this original germ theory of creation to a growing knowledge of embryos, fossils, and the anatomy and distribution of living animals and plants.

First of all, then, during the eighteenth century, comes the idea of a "species" in our modern sense as in itself a natural group, and as itself the unit in the creative process, rather than the individual germ of Bonnet's doctrine. With the idea of "species," therefore, comes the second form of the general Creation Theory.

Folk botany seems always to have recognized that, for example, a black oak and a white oak and a red oak, though different from one another, are nevertheless not so different as each is different from, let us say, a walnut. Folk botany has also seen that the acorn from each sort of oak grows into a tree of its own sort and not one of the others. So all the oaks get named by the same noun for the "genus" with an adjective added for the "species." Folk zoölogy tends to name the animals after the same plan—gray wolf and timber wolf; black, brown, polar, and cinnamon bears. But it is all pretty vague at best, and there is seldom much thought of relationship beyond the bears or the oaks. In addition, folk natural history has always noted that bears and wolves are far more like one another than either is like any bird, and that oaks and walnuts are a fundamentally different thing from ferns and mosses.

Aristotle, who was much given to seeing everything first, tried to make usage more accurate. He called a *genos* such creatures as are in a general way alike, but only in the most general way, making a separate *genos* of mammals, of birds, of reptiles and amphibia together, and of fishes, with another four *genea* for all the rest of the animal kingdom. A *genos*, therefore, among the vertebrates, is just about what we now call a class, but is a much wider group for the small and less familiar creatures. He called an *eidos* whatever animals or plants breed together or come true from seed. *Eidos*, therefore, is very near our "species." The two words became common Greek scientific usage.

As Aristotle, in the Middle Ages, was dressed over into Latin, the two logical categories *genera* and *species*, readily came to take on a special biological meaning with *species* about equivalent to *eidos*, but a *genus* much smaller than Aristotle's group. Even as late as 1700, however, John Ray, to whom we owe the beginnings of our modern classifications of living things, writing English, sometimes puts "*species*" in italic as a foreign word; and Bonnet, throughout the *Contemplations* uses species only in the vague sense of "kind," writes indifferently of a species of animal or of rock, and has no sense whatever of our present-day idea of community of origin—as, of course, he could not have consistently with his Germ Theory of Creation.

With John Ray, about 1700, begins our modern era of sharp ideas. He helped to start the fashion of accurate and verifiable descriptions of plants and animals, and being interested in fossils also, he helped to introduce a detailed and accurate study of these in place of the open-mouthed wonder of former days. Thanks in part to Ray, the world passed from folk knowledge of plants, animals, and fossils to scientific.

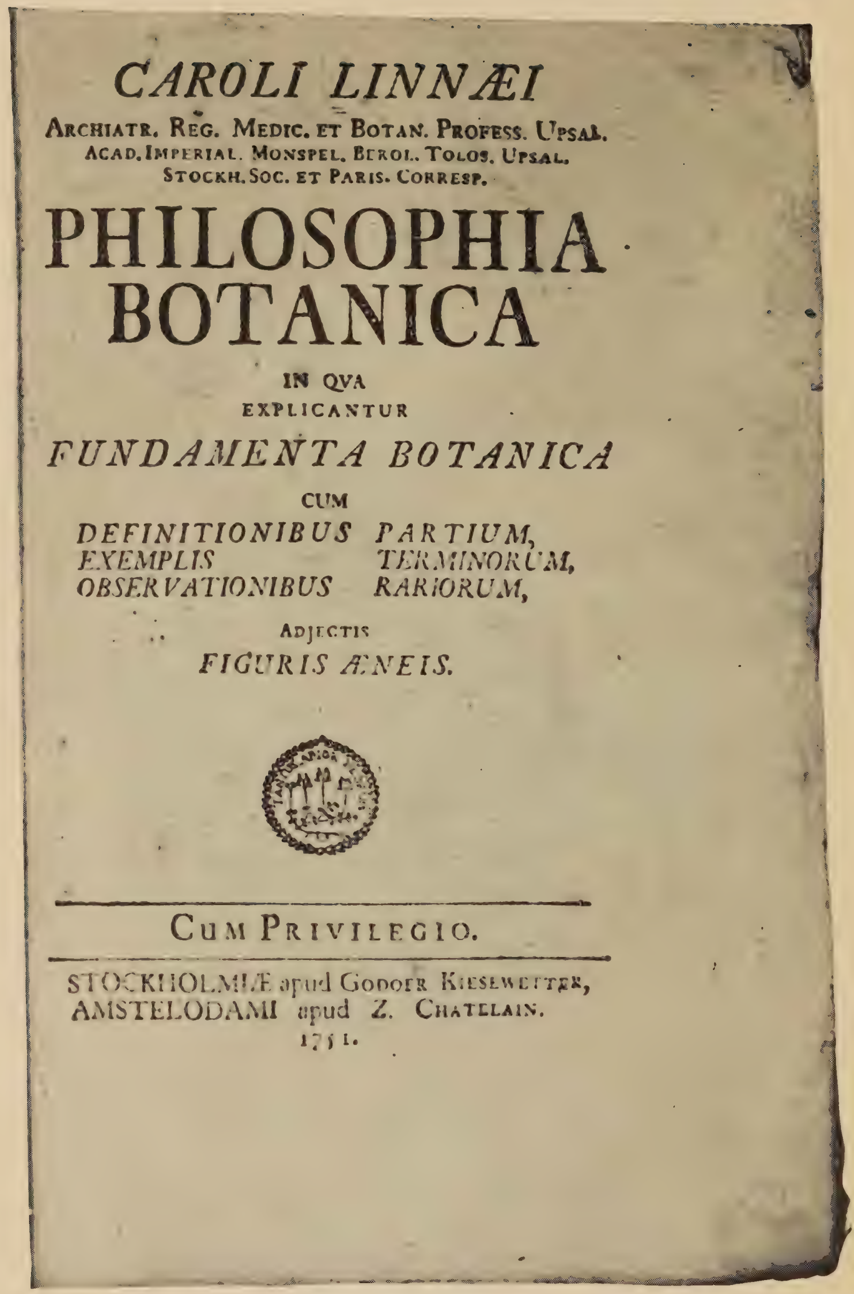
The great problem for these early systematists was to identify certainly the creature that they saw, by description in print. Plants and animals were named—of course in Latin—birches or bears, and one who read descriptions guessed pretty correctly that his author did not mean willows or wolves. Then followed a sentence or a paragraph, also in Latin, with the more precise account, from which an author always hoped that his reader would manage to make out the particular birch or willow, bear or wolf, that was under discussion. But since there are some two hundred different sorts of willows on the earth, one easily imagines that identifying each of them by a description in a Latin paragraph had its inconveniences.

The man who ended all this confusion and uncertainty was Karl von Linné, or as he called himself after the fashion of his time, Carolus Linnæus, who was born in Sweden in 1707, became the leading naturalist of his generation, taught botany in the University of Upsala, and died full of years and honors in 1778.

Linné retained the ordinary Latin names of what we now call genera, that everybody was supposed to know—*felis* and *homo* and *canis* and the rest—calling them always Latin nouns. In place of the long Latin descriptions, he substituted a single Latin adjective, the "trivial" name, *domestica, familiaris, albus, Canadensis, vonhouteii,* and the rest. Thus arises the familiar "binomial system," with its *Homo sapiens, Lynx Canadensis, Spirea vonhouteii, canis familiaris,* to some millions of described animal and plant species.

Carolus Linnaeus. M.D.
S. R. M. Sueciae Archiater, Medic. et Botan. Profess.
Upsal. ord. in Horti Academ. Praefectus, nec non Acc.
Imper. Nat. Curios. Dioscorides 2dus Upsal.
Stockh. Berol. Monsp. et Paris. Soc.
Natus 1707 May 13
Delin 1748

Karl Von Linné (1707–1778)



CAROLI LINNÆI
ARCHIATR. REG. MEDIC. ET BOTAN. PROFESS. UPSAL.
ACAD. IMPERIAL. MONSPEL. BEROL. TOLOS. UPSAL.
STOCKH. SOC. ET PARIS. CORRESP.

PHILOSOPHIA
BOTANICA

IN QVA
EXPLICANTUR
FUNDAMENTA BOTANICA
CUM
DEFINITIONIBUS PARTIUM,
EXEMPLIS TERMINORUM,
OBSERVATIONIBUS RARIORUM,
ADJECTIS
FIGURIS ÆNEIS.

CUM PRIVILEGIO.

STOCKHOLMIÆ apud GODOFR KIESEWETTER,
AMSTELODAMI apud Z. CHATELAIN.
1751.

Title page of *Philosophia Botanica* by Linnæus.

A student, therefore, coming across a new form, has only to give it a name, write out as good a description as he can, deposit his type specimen in the museum of his university, and send duplicates to as many other collections as he likes, to have that particular creature forever afterwards known to science unequivocally. Whoso wants to learn what any other man is talking about, looks up the original description under the name. If there is any further doubt, he looks up the type specimen or its dulpicate.

Linné devoted most of his life to naming species after his system, and his great *Systema Naturæ,* of which no fewer than twelve editions, each revised by Linné himself, appeared between 1735 and 1766, became the starting point of everything that has been done since in the detailed study not only of living species but of fossil species as well.

The result was, practically, for nearly a century, to make the identification and naming of animal and plant species pretty much the whole of zoölogy, botany, and paleontology. He was the best naturalist whose collection contained the largest number of dried plants or stuffed animals or fossil shells, correctly labeled. He was the greatest authority who could carry in his head the greatest array of Latin names, and assign them correctly to any specimen. "Species making," for a hundred years, simply was Natural History.

The practical effect of this absorption of natural science in species making was to break up the Aristotle-Bonnet "ladder" into independent groups. The individual animal or plant no longer counted. If it went into a species, that was all one cared to know. If it did not, it commonly got conveniently mislaid, and did not interfere with the system of separate and rigidly defined "species." The idea, therefore, of the *échelle* disappears. The organic world is not a uniform string, but a set of discontinuous beads.

Inevitably, therefore, the world turned from the notion of independent created germs, that await for ages their favoring environment and then evolve to visibility, to the quite different notion of a created ancestor from whom, by natural generation, all similar beings afterward descend. There are, then, no germs to be wafted in the air or locked up inside female bodies. Creation is by adults, and the young arise from them by epigenesis, not by evolution. The Germ Theory of Creation gives way to the theory of created pairs.

But practical human beings can not but notice that offspring are rarely quite like their parents. One notes it in his own kin. One sees it in his flocks and herds, and in the crops that grow out of his sowings. Evidently, then, the named species of Linné and others is not an absolutely fixed unit.

On the other hand, there is sometimes precious little difference between two species to which a trained naturalist insists on giving different names. The householder, for example, who has paid for a lawn planting of Fraser's fir, but suspects that an unscrupulous nurseryman is passing off the common balsam fir instead, referring to the botanies, will learn that "*Pinus balsamea,* Linnæus" differs from "*Pinus Fraseri,* Pursh" in that the leaves of one are "mostly obtuse," those of the other "mostly emarginate"; all of which means no more in plain English than that most of the leaves on one tree have notches at their tips about as big as the point of a fair-sized pin, which the other species rather more generally lacks. That is the only certain difference that holds for those two trees throughout life. Naturally, this distinction of species does not sound especially important. The man in the street can not help seeing that domesticated dogs, for example, which count as a single species, are vastly more unlike than their cousins the wolves that make at least a dozen.

Inevitably, then, once given this second phase of the Creation Theory in which the unit of creation is the original pair, the question must arise, Does this original pair represent the modern genus, or the modern species? In other words, was there present in the Garden of Eden and brought to Adam to name, a pair of dogs, a pair of gray wolves, a pair of coyotes, a pair of jackals, a pair of dingoes, and so on down the list; or was there only one ur-wolf in Eden, from whom have descended the dozen present-day sorts, modified by climate and food? Was there one pine tree after its kind, or some hundred or so? That an original Edenian could have fathered any larger group than the genus does not occur to anybody. Eighteenth century natural history is interested only in genera and species.

Linné himself, on this point, somewhat wavered in opinion. Before his day, as the idea of genera and species was taking shape, general opinion had it that the first created thing is forebear to the entire genus. From Adam and Eve come all mankind, with no small range from African to Mongol. From an ur-wolf spring all wolf-like animals; from a *proto-pinus* all the pine trees from dwarf *P. mughus* to Norway giant. Linné himself was brought up on this opinion.

Later, seeing how constant species are under changed conditions, he altered, through his middle period, to the familiar and traditional theory that creation is by species—the dozen wolves, the thirty cats, the hundred pines, the thousand not unfamiliar birds, the uncounted species of insects. Linné, however, did not guess that in North America alone there are seven thousand named species of butterflies and moths, over ten thousand beetles, just about ten thousand bees, and nearly ten thousand true flies.

Linné, therefore, went ahead confidently with his species as the unit in creation. A "species" is, by definition, all the descendants of one original created pair. "*Tot numeramus species,*" wrote Linné, "*quot ab initio creavit infinitum ens.*" "*Species tot sunt, quot formae ab initio creatae sunt.*" Only we must remember that naturalists of Linné's time were wont to make both their species and their genera appreciably larger groups than it is the fashion to call by those names now. Linnæan species are sometimes nearer our genera, and Linnæan genera are almost like our families.

Later in life, as Linné's disciples and Linné himself piled up named species of animals and plants, Linné seems to have weakened not a little on the opinion of his middle period. The number of species was running far up into the thousands, with most of the world unexplored and only the more obvious creatures described even in Europe. Adam would have to name, Noah would have to preserve in the Ark, numbers of which simple-minded days had not dreamed. So Linné rather inclined to return to his first view that genera, not species, are the created units; and his dictum, "*nullae species novae*" drops out of the latest text of the *Systema*. But by that time opinion had set immovably. Species were the reality. Genera are only convenient groups of similars.

Thus it came about, because of the overwhelming authority of Linné, that "creation" has, since about 1750, meant more and more universally the creation of "species." By about 1800 the creation of germs instead of pairs has been pretty much forgotten; and the Bible is everywhere assumed to teach "Linnæanism."

Of course, the Bible really does nothing of the sort. Genesis 1 can not narrate the creation of species, because "species" is an eighteenth century idea, quite foreign to the mind of man up to about 1750. If Moses had intended that idea, there is no possible way by which any mortal tongue could have conveyed the information. Moreover, there is no hint in Scripture that creation was by pairs at all. All we are told is that pairs and sevens of certain "kinds" went into the Ark; the rest is guessing. Even so, the Linnæan rendering, a pair of each species created in Eden, became the orthodox exegesis of the creation narrative. This it remains to the present time. The controversy over Creation or Evolution has always since Linné's time been over the creation or the evolution of Linnæan species.

"Linnæanism," as we may best call this second phase of scientific Creationism, faced a rather simple situation up to about 1800. The known plants and animals were mostly those of western Europe, and nobody had to consider whether the remainder of earth is or is not inhabited like that small district. The known animals and plants were mostly land forms and large, and nobody had to consider whether the creatures of the sea are like those on land, and whether the simpler and smaller forms, yet undescribed, are like the more familiar things. Most of all, fossil creatures had been wondered at; they had been only feebly studied in detail.

Linnæanism is then a simple doctrine. There are the created pairs of Eden, one for each Linnæan species; and from Eden they make their way to wherever on earth they now appear. Many individuals indeed, of various species, perished in the Great Deluge; but one pair at least of each came through in the cargo of the Ark, and once more replenished the earth. Every living thing, therefore, if its pedigree could be run back, finds the beginning of its ancestral line in Eden in 4004 B. C.

One point only is uncertain. As men begin to study actual fossils, they can not help noting that some at least of those which they dig out, are not like anything which they are used to seeing anywhere alive. Nothing, to be sure, especially remarkable turned up much before the end of the eighteenth century—some shells in British cliffs that do not appear in British seas, some elephant bones, that being mistaken for human, proved that "there were giants in the earth in those days" as Scripture says. Still, the question does arise, whether the present-day creatures of earth are all that there ever have been, or whether, on the other hand, certain species, once created, have become extinct.

On this point, eighteenth century opinion is nearly unanimous. We certainly do not know that the fossil creatures of our cliffs are not alive somewhere on earth. Most of them are sea animals, most of them are small—and the sea is wide and deep. To suppose that they are not still living somewhere, but have become extinct since the first creation, is something which, as John Ray puts it, "Philosophers and Divines are unwilling to admit, esteeming the Destruction of any one *species* a Dismembering of the Universe, and rendering the World imperfect; whereas they think the Divine Providence is especially concerned, and solicitous to secure and preserve the Works of the Creation. And truly so it is, as appears, in that it was so careful to lodge all Land Animals in the Ark at the time of the general Deluge: and that, of all animals recorded in Natural Histories, we can not say that there has been any one Species lost, no not the most infirm, and most exposed to Injury and

Rapine. Moreover, it is likely that as there neither is, nor can be any new Species of Animals produced, all proceeding from Seeds at first created; [Ray, of course, belongs to the Germ Theory era, not the Linnæan] so Providence, without which one individual Sparrow falls not to the Ground, doth in that manner watch over all that are created, that an entire Species shall not be lost or destroyed by any Accident."

Still, Ray does have growing suspicions; and one of his reasons for rejecting the flood theory of fossils and accepting the germ theory instead is that if you once admit that fossils were ever real and living animals, you may be driven to admit also that some of them have perished completely off the earth. On the whole, for Ray, early in the century, created germs are a safer theory than created pairs.

One further difficulty Linnæanism, even in the eighteenth century, is constrained to meet. Species, as a matter of theory, are the God-ordained units of the organic world, separate from the beginning, clearly defined now. As a matter of practise, no two experts agree on what the actual species are which they label and store away. There are, to begin with, the temperamental "lumpers," who make their species as large as may be and put as many different sorts of creatures as they can manage under each label. There are, on the other hand, the "splitters," who like to fuss over minute points and are never so happy as when they make two species grow where none grew before. Each expert, in short, "makes" his species a good deal to suit his own ideas. No expert ever has full confidence in another's list. In addition, just as all the species of a group in one district are nicely straightened out to the satisfaction of everybody except a handful of specialists who are sure that everything is all wrong, along comes a traveler from another district with a lot of new material, which simply will not fit into the scheme of species as arranged. So the whole task has to be done over again; and men can not help asking, If species are real things, God's units in Creation, why can no mortal man make out just what each species is?

However, this objection is disposed of by remarking on the limits of the human mind. If we knew all, we could explain all, and everybody would agree just where each species begins and ends. Both objections to the Linnæan theory then, rest on ignorance. Both are answered. Linnæanism, the second phase of the general theory of Creation, dominated European opinion from the middle of the seventeen hundreds to beyond their end.

Its main points sum up thus:

Each species as described in the current botanies and zoölogies has been specially created as a single adult pair, all at the same time, and all at the same place.

The offspring of these original pairs, as numbers increase, make their way as best they can over the earth. We find them now where they have wandered.

Species being real things and not merely convenient groups of things not worth distinguishing further, it does not comport with divine foresight that any species should perish, either in the Flood or by any accident. All fossils, therefore, wherever found, are of the same species as other animals and plants that are still alive somewhere on earth.

In short, there is but one date of Creation, and but one creation center, and no species, once created, has ever become extinct.

This is, in outline, the second main Creation Theory that may fairly be termed scientific in any moddern sense. It lasted out the eighteenth century in the learned world. In the nineteenth it had to meet quite as formidable objections from a growing science as did the Germ Theory which it supplanted. Even now it is widely held, and still more widely supposed to be set forth in Holy Writ.

Again appears the irony of history. The man who invented this, the most widely accepted and the longest lived of all scientific Creation Theories, himself abandoned created species in the wisdom of his old age!

CHAPTER XI

THE EVOLUTION OF CREATIONISM

BETWEEN the Germ Theory of Creation and the Linnæan, there must needs be a break. Both theories can not be true. Neither can grow out of the other or compromise with it. As creation by pairs came in, therefore, creation by germs went out.

Linnæanism, however, unlike the older doctrine, had in it the elements of growth. It did not, then, so much make way before later forms of Creationism as evolve into them. The history of this evolution of Creationism from Linné, through Cuvier and Agassiz and Lyell to Darwin, is no small part of the history of zoölogy, botany, and paleontology from the beginning of the nineteenth century to the end of its sixth decade.

Next to Linné, therefore, in the story of Creationism, stands Georges Chrétien Léopold Frédéric Dagobert Cuvier, Baron of France under the first Napoleon, member of most of the learned societies of Europe, and the outstanding figure in the natural history sciences of his day as Linnæus had been in his.

Cuvier was born in 1769 and died at the summit of his reputation and honors in 1832, so that his life just about spans the interval between the speculative period of the natural history sciences in the eighteenth century and the properly scientific period of the nineteenth. When Cuvier was born natural science was still the handmaid of theology. When he died, thanks in part to his own labors, natural science was fast becoming a thing in itself.

The man himself explains his opinions. He was a great administrator who held important political office in trying times and was responsible for the welfare of important institutions both scientific and civil. It was, then, no part of his duty to take sides in any controversy. Moreover, for all the number of his published volumes and for all the enormous sweep of his ideas, he was essentially reticent. Mrs. Buckland, who, before she married the President of the British Association, had made drawings for Cuvier's books, describes him as "very taciturn, and so cautious that he never utters an opinion in company." In addition, Cuvier had the perfect scientific mind, that sets itself to solve problems, not to elaborate systems. One must, then, to understand his views, remember always that Cuvier entertained a great many ideas that never have got into print.

At least as young as fourteen—for like many another genius he was a precocious lad—Cuvier took to reading Buffon, whom he continued to admire throughout his life. Now Buffon, who died in 1788, counts as one of the advance guard of modern evolutionists, albeit of the speculative rather than the scientific period, which latter is commonly taken to begin with Lamarck, whose lifetime just about matches Cuvier's. In youth, then, Cuvier inclined decidedly to evolutionary opinion. That for most of his life, the one man in all the world who probably knew most at first hand concerning the essential facts is also one of the great figures in the history of Creationism, speaks volumes as to the side on which the weight of evidence lay as the eighteenth century passed over into the nineteenth. Altogether then, Cuvier's views that he thought worth getting into type, are as safe a guide as one is likely to discover to the soundest opinion of his day.

At the same time, one must not forget that no man becomes a Chevalier of France, tutor to an emperor's son, Chancellor of one of the world's leading universities, an Inspector-General of Education, an Imperial Commissioner to plan the defense of his country against invasion, Counsellor of State under both Emperor and King, while he lectures at the *College de France,* is perpetual Secretary of the Institute, and Curator of Vertebrate Fossils in the *Jardin des Plants* —all of which, and many more like them, Cuvier was —and at the same time be given to doubtful disputa-

George Cuvier (1769–1832) From an old engraving.

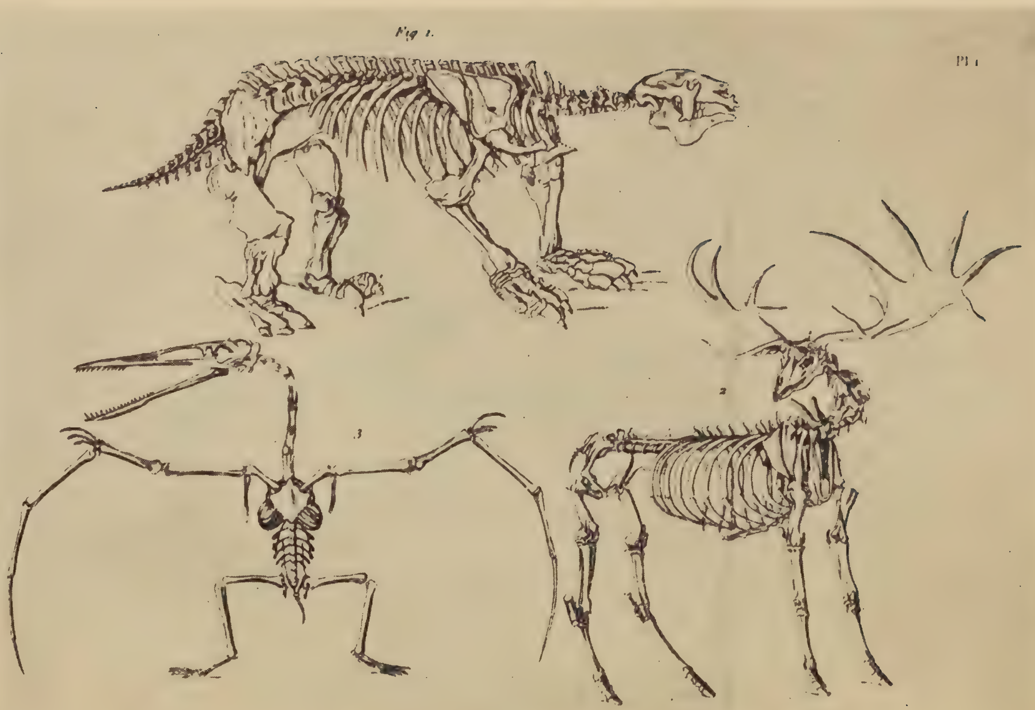


Fig. 1. Squelette de Megatherium. *2. Cerf à bois gigantesque* *3. Pterodactyle à museau allongé*

Three fossil animals which Cuvier correctly believed to be extinct.

A plate from a Paris edition, 1851, of the *Discours Sur Les Révolutions Du Globe*, which is the first portion, printed separately, of *Recherches Sur Les Ossemens Fossils.*

tions and leading forlorn hopes. Cuvier was a tactful man. Cuvier had also vast interests at stake—and Napoleon was cultivating the state church. Cuvier, in addition, always inherently scientific, had a real horror of unbased speculation. Altogether, one very much suspects that if we really knew all that went on in Cuvier's mind, we should find his Creationism decidedly more forward-looking than sometimes appears.

Cuvier did, to be sure, cling to the pre-formationist embryology. That was, however, doomed; for the progress of microscopical technique early in the nineteenth century was bound in any event to settle the point in favor of Harvey and Aristotle. But Cuvier himself was no embryologist, so that his authority on the wrong side was no great matter either way.

On the other hand, Cuvier quite turned his back on any sort of *échelle des êtres.* Thus in the preface to the first edition of his great work *The Animal Kingdom,* written in 1816, he declares, "To anticipate a remark which will naturally present itself to many, I must observe that I have neither desired nor pretended to class animals so as to form one single line, or so as to mark their relative superiority. . . . The pretended chain of beings, as applied to the whole creation, is but an erroneous application of those partial observations, which are only true when confined to the limits within which they were made—it has, in my opinion, proved more detrimental to the progress of natural history in modern times, than it is easy to imagine."

Another passage on the same topic, from another source, is worth quoting at length for the light it throws on several of Cuvier's ideas. "Let it not be imagined, because we place one genus or one family before another, that we consider them as more perfect, or superior to another in the series of beings. He only could pretend to do this, who would pursue the chimerical project which we have long renounced. The more progress we have made in the study of nature, the more we are convinced that this is one of the falsest ideas that has ever resulted from the pursuit of natural history; the more we have been convinced of the necessity of considering each being, each group of beings, by itself, and the part it plays by its properties and organization, and not to make abstraction of any of its affinities, nor any of the links which attach it, either to the beings nearest it, or to the most distant from it. Once placed in this point of view, difficulties vanish, all arranges itself for the naturalist: but systematic methods only embrace the nearest affinities; and by placing a being only between two others, they will always be wrong. The true method is, to view each being in the midst of all others: it shows all the radiations by which it is more or less linked with that immense network which constitutes organized nature; and it is this only which can give us that great idea of nature, which is true, and worthy of her and her Author: but ten or twenty rays often would not suffice to express these innumerable affinities."

Following out these principles, Cuvier, in part returning to Aristotle and altogether breaking with Bonnet, develops the classification of the animal kingdom that is the foundation of all our present-day notions. The Biblical "beasts, birds, fishes, and creeping things," had become by Cuvier's time the familiar and proverbial "beasts, birds, fishes, and insects." But, obviously, if one knows the least general anatomy, "insects are a many times larger group than beasts, birds and fishes all combined. The whole idea, Biblical and traditional alike, is basally wrong."

Cuvier, on the contrary, was basally right. His "vertebrates" are the older "beasts, birds, and fishes" combined, with the reptiles and amphibia added. The "insects" he split into the coördinate groups, "Articulates, Molluscs, and Radiates." It remained, then, for subsequent anatomists—of whom Huxley was important—to split up the Radiates into Protozoa, Porifera, Cœlenterates, Echinoderms, and Worms, and to split off certain aberrant groups like the acidians and the brachiopods, to have all our modern scheme of the relations among animals. Until something of the sort is done, and the world has a sound notion of how the parts of the animal kingdom fit together, there is no making out any time order in creation. Cuvier began the process of definition. He carried it far enough so that, beginning with his day, the fact that certain creatures occur in certain strata and certain others elsewhere, took on meaning. But so long as men lumped together as "insects" a lower Cambrian trilobite and present-day clam, there is no real point to geologic ages.

The same admirable principles, Cuvier applied also to the subdivisions of his main groups, "preferring," as he said everywhere to vague and all-embracing schemes, "the honest avowal of these irregularities, if we may be allowed to call them so, to those errors which must arise from leaving those species, and anomalous genera, in a series, the characters of which they do not embrace." In brief, as Linné had cut up the continuous Ladder of Life into discontinuous species, so Cuvier in turn cut up Linné's continuous series of species into the discontinuous larger groups of which we now recognize about a dozen. We have to reckon, then, with a double discontinuity in nature —a gap between species and a gap between the larger groups. It was Darwin's task to bridge the gap between Linnæan species. The larger groups of Cuvier still resist connection.

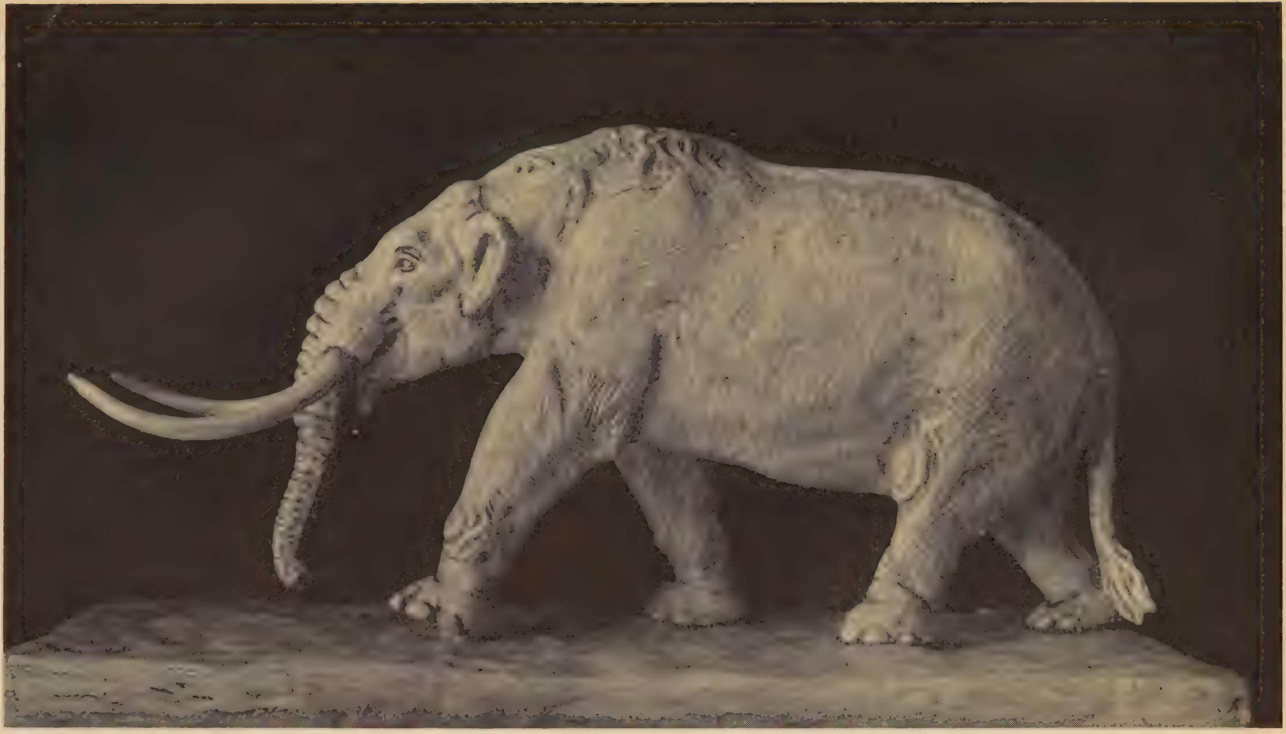
Meanwhile, one William Smith, surveyor and engineer, in the course of business, his eyes wide open, tramped the byways of fourteen English counties, several thousand miles a year. Smith saw the British strata "like slices of bread and butter" piled one above another. Smith saw, also, what no one else had seen so clearly except only the German, Werner, that each rock layer, if it has fossils at all, has a characteristic set, unlike any other above or below.

Its fossils, therefore, identify a stratum. And since, necessarily, in undisturbed rocks, the older layers always must underlie the more recent, it becomes only a matter of time and patience to reconstruct the "geologic column" of all the strata of a large district, layer above layer. This done, it appears at once that geologic time is enormously long, some thousands of times greater, at the very least, than Archbishop Usher's chronology. Smith, in short, proved the "geologic column"; and the scientific world forthwith adopted the "long chronology" for Creation, together with the succession of animals and plants in the rocks, from the bottom layers up, as the order of their appearance during Creation Week.

Smith expounded his ideas in successive volumes, mostly between 1816 and 1819, and he influenced profoundly Cuvier along with the rest of scientific mankind. The result of his labors was to focus attention on the single stratum and its contained fossils, on the order of succession of strata, and on the conditions under which each separate stratum appears to have been formed, in place of mere vague collecting of remarkable objects and assigning them Linnæan names. In particular, the divisions of Paleozoic time came to be established on the basis of the stratified rocks of England and Wales.

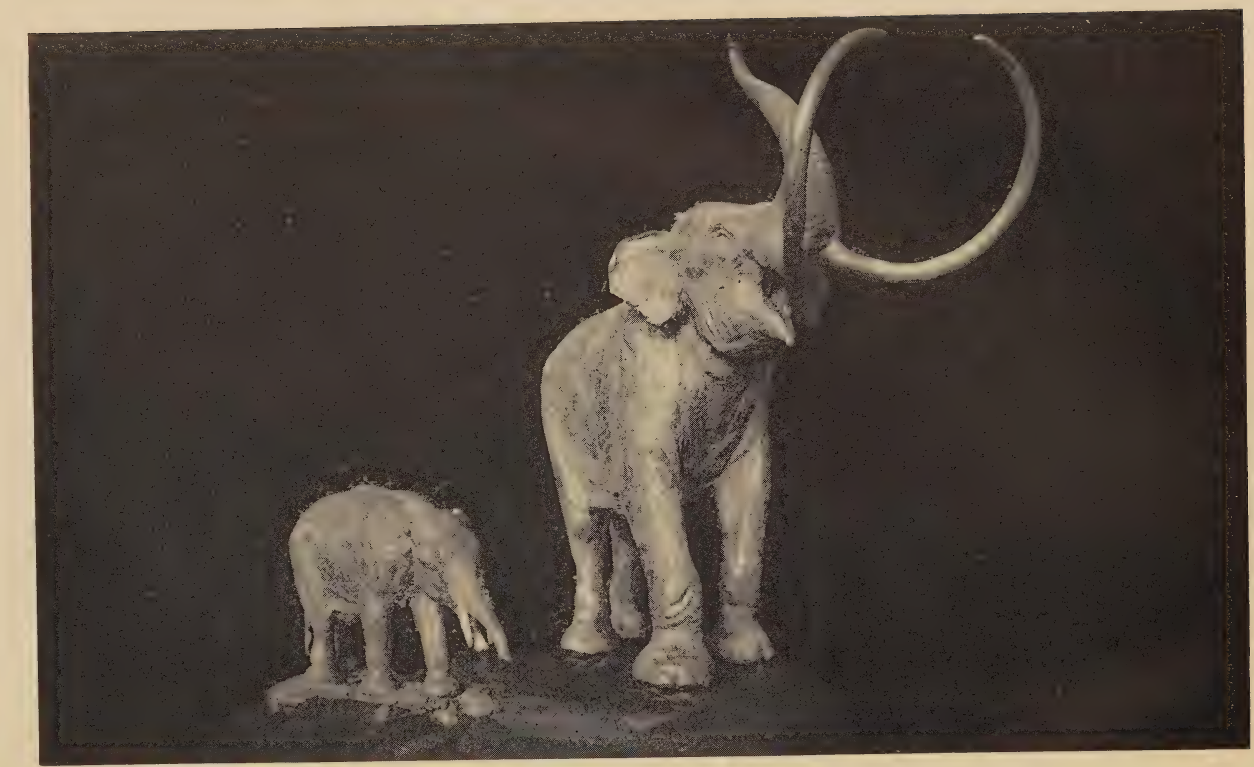
But Cuvier was not in Britain but in Paris, at the *Jardin des Plantes,* where he was building up year by year the greatest collection of fossils in the world, and mastering the detail of them as no other man on earth had done. Now, one of the important things about Paris is that it is located in the Paris Basin. And one of the important things about the Paris Basin is that it consists, structurally, of a highly fossiliferous series of stratified rocks, not like most of those of Great Britain of Paleozoic age, but of Tertiary. So France under Cuvier becomes the norm for the divisions of the late geologic time, as Britain for early under William Smith.

Cuvier was essentially an anatomist. But even before he came to Paris, in the early half of the seventeen nineties, when as a young man in Normandy he was working on molluscs, he had grasped the idea that the anatomy of living things and the anatomy of fossil ones is all one science. This idea, carried out with



A Mastodon of which Cuvier discovered and named several species. The Mastodons are primitive elephants, now extinct, which though they have trunks and tusks are otherwise less unlike ordinary mammals than the elephants are.

Courtesy of *American Museum Natural History*. Model by Charles R. Knight.



Two Extinct Probocidians.

On the left, a long-faced, four-tusked Mastodon. These primitive mastodons are found fossil both in North America and in Europe. One species was described and named by Cuvier himself. On the right, a gigantic elephant of the modern type.

Courtesy of *American Museum Natural History*. Models by Charles R. Knight.

enormous insight and industry, made the whole great science of Comparative Anatomy, of which Cuvier is justly credited with being the founder.

Things do sometimes fall out handily, "coming as if called." Cuvier reached Paris in 1795, an extraordinarily able man, equipped with new and sound ideas concerning the classification of the animal world, fired with zeal to correlate living and fossil species and so make one anatomical hand wash the other; and he dropped into the Paris Basin at just the moment when Napoleon was rebuilding Paris, and every quarry in the Paris district was literally running full blast.

Cuvier was important and powerful and rich. Napoleon was ripping the insides out of the Paris hills. The rocks teemed with Eocene fossils, and nobody, virtually, before that day, had done any real work on the Age of Mammals. Some thousands of quarrymen saw their bread and butter involved in getting every sign of shell or bone uninjured into the laboratories of the *Jardin des Plantes*. Cuvier from this and other regions picked up, of the larger mammals alone, the fossil skeletons of various bears, hyenas, dogs, tigers, horses, deer, pigs, oxen, buffaloes, a rhinoceros, a hippopotamus, two tapirs, five separate species of mastodon, along with a vast number of individual mammoths, which before Cuvier took them in hand had been taken to be the bones of human giants. In addition, out of strata obviously fresh water, Cuvier unearthed five species of anoplotheres and ten species of *Paleotherium*, both Eocene.

These last, in particular, brought to a crisis an old problem. For a hundred years, collectors of fossils, mostly British, had been arguing over the question whether, for example, the "Cuthbert beads" which the children picked up from the talus and strung for necklaces are or not to be found as parts of a living animal anywhere on earth. Ecclesiastical folk-lore had it that,

"On a rock by Lindisfarne
St. Cuthbert sits and toils to frame
The sea-born beads that bear his name."

Theological opinion was unanimous that no species once created could ever perish, and scientific information certainly did not extend to denying that any imaginable species of sea-lily does not still wave its tentacles in the bottom of some uncharted sea.

But Cuvier's discoveries quite altered the whole aspect of that question. It is one thing to surmise that a crinoid stem the size of a child's finger may be growing somewhere on the ocean's floor, or even one of the big ammonites that Buckland used to wear round his neck after he had crammed the last possible fossil into his famous bag. But a dinothere the size of an elephant is a different thing, and the great St. Petersburg mammoth which in 1799 first began to thaw out of the Lena delta—fossils, fittingly, keep their old names in spite of economic revolutions—was reported to western Europe by Cuvier himself.

Cuvier, with characteristic pains, went into the whole question of how far a large animal, dwelling on the land, can remain unknown to science. First, he reviewed all Latin literature, accounts of games and pageants along with natural histories, and made out just what species of fairly large creatures were known in ancient times. "The museum of the Vatican," he notes with characteristic accuracy, "has the figure of a crocodile in basalt, almost perfectly represented except that it has one claw too many on the hind feet." Then he checked this list against the known animals of the world of his own day. The result is to show that the more important and obvious wild animals known to a Roman of the first Christian century from Europe, Africa, and Asia, are substantially the same as those known to a Frenchman of the nineteenth. Nothing new, even to the great apes, has been discovered in two thousand years.

But the Eocene mammals of the Paris Basin and nearby districts and of various other parts of the earth which Cuvier knew, are as large as anything on land now, and their fossil bones prove that there were at least as many different sorts. Therefore, if the

Eocene group as a whole is now living anywhere on earth, some examples must have been seen by somebody sometime. But nobody, anywhere on earth, has reported a single individual out of the long array of paleotheres and dinotheres and anoplotheres and megatheria and Irish elks and Siberian buffaloes, cave bears as large as horses, woolly rhinoceroses, and the various sorts of extinct mammoths, mastodons, and woolly elephants. There is no escaping the logic. Certain species once created have certainly perished from the earth. Presumably, therefore, many have; and the reason why no man has seen the originals of St. Cuthbert's beads and horns of Ammon growing alive off French and British coasts, is that there are none just like them left anywhere on earth.

Here, then, is the first step in the evolution of Linnæanism, and the third of the scientific Creation Theories to develop after 1700. It turns out that the natural history of creation is not so simple as it appeared to Linné. There have been vast geologic revolutions; and many species, probably at least as many species as are now alive, have perished altogether.

The question then comes: If some species become extinct between the first creation and modern times, are other species created in that period to replace them?

Cuvier himself at first inclined to the opinion that there have been new creations. Afterwards he changed his mind. There is a principle of scientific reasoning called the Law of Parsimony that runs, in effect, When in doubt, take the simpler explanation; or in the more technical language of the late Middle Ages, *Entia non sunt multiplicanda praeter necessitatem.* Cuvier could prove that certain large mammals are not now living on earth. He could not prove that these animals were not alive at the end of the sixth "day." Therefore, his working theory had to be that there has been no new creation since the beginning, but only wholesale extinction.

Nevertheless, there are certain rather obvious facts that do point toward creation subsequent to the first creation week. William Smith had shown that species come and go, each for the most part characteristic of a thin layer of rock. Cuvier himself had made out that in the Paris Basin there is, low down, a limestone that is obviously marine; and over this, a bed of gypsum that contains the bones of quadrupeds and birds, with remains of fresh-water fishes and land molluscs. Evidently, then, land and sea have here changed places at least once. But above the gypsum comes another ocean deposit; and above that, another set of fresh-water layers; with the alluvium above all, not yet, of course, divided into glacial and post-glacial beds. The fossils of each of the five formations are peculiar to it alone. They might well all have been created in turn as the cycle changed.

On the other hand, the incursions and retreats of the sea are clearly local; and as detail comes to be more and more clearly made out, it becomes obvious enough that, especially during the later portions of geologic time, a small area of land goes up and the sea runs off, it sinks and the sea runs in. Many individual creatures, we may well suppose, are drowned; but the rest might easily migrate, and there is no certain evidence anywhere that any entire species is ever wiped out.

In short, argues Cuvier, "I do not pretend that a new creation was required for calling our present races of animals into existence. I only urge that they did not anciently occupy the same places, and that they must have come from some other part of the globe. Let us suppose, for instance, that a prodigious inroad of the sea were now to cover the continent of New-Holland [i. e. Australia] with a coat of sand and other earthy materials; this would necessarily bury the carcasses of many animals belonging to the genera of *kanguroo,* . . . *echidna,* and *ornithorynchus,* and would consequently entirely extinguish all the species of all these genera, as not one of them is to be found in any other country. Were the same revolution to lay dry the numerous narrow straits which separate

New-Holland from New-Guinea, the Indian Islands, and the continent of Asia, a road would be opened for the elephants, rhinoceroses, buffaloes, horses, camels, tigers, and all the other Asiatic animals, to occupy a land in which they are hitherto unknown. Were some future naturalist, after being well acquainted with the living animals of the country in this supposed new condition, to search below the surface on which these animals were nourished, he would then discover the remains of quite different races."

In all this, Cuvier was entirely right; and the work of the next hundred years on the past distribution of land, water, animals, and plants on the earth, but confirmed many times over the correctness of his views. There have been vast-scale sinkings and risings of the lands, and many of them. There have been, in consequence, vast slaughtering and vast migrations. Cuvier was basally right. The facts known to him are covered by migrations without re-creation.

To sum up, then, this third form of Creation Doctrine as it left the hands of the founder of Comparative Anatomy: Linnæan species are the unit of creative acts as Linné taught; and their creation is presumably by adult pairs. Once created, the various species scatter themselves as they can over the earth. In place, however, of the single migration from the creation center in Eden, we now have the picture of many migrations back and forth as habitable lands come and go, or as growing and shrinking seas bring in or abandon ocean floors. Instead of all species, once created, lasting through till the present day, we have now the picture of large-scale extinctions, that are afterwards made good by more migration to and fro. Altogether, this beginning of a theory of Catastrophes is a distinctly more complicated affair than the simple Linnæanism that it is superseding. It must be, for it has to explain many more facts. Linné, in his theory, took account of the present only. Cuvier, in his, sweeps geologic time.

All this, inevitably, affects a developing Flood Theory. The rocks prove many catastrophes. The Bible recounts one in detail and hints at others before it. Cuvier sums up:

"I am of the opinion, then, . . . that if there is any circumstance thoroughly established in geology, it is, that the crust of our globe has been subjected to a great and sudden revolution, the epoch of which can not be dated much farther back than five or six thousand years ago; that this revolution had buried all the countries which were before inhabited by men and by the other animals that are now best known; that the same revolution had laid dry the bed of the last ocean, which now forms all the continents at present inhabited; that the small number of individuals of men and other animals that escaped from the effects of that great revolution, have since propagated and spread over the lands then newly laid dry; and consequently, that the human race has only resumed a progressive state of improvement since that epoch, by forming established societies, raising monuments, collecting natural facts, and constructing systems of science and of learning.

"Yet farther,—That the countries which are now inhabited, and which were laid dry by this last revolution, had been formerly inhabited at a more remote era, if not by man, at least by land animals: that, consequently, at least one previous revolution had submerged them under the waters; and that, judging from the different orders of animals of which we discover the remains in a fossil state, they had probably experienced two or three eruptions of the sea.

"These alternate revolutions form, in my opinion, the problem in geology that is most important to be solved, or rather to be accurately defined and circumscribed; for, in order to solve it satisfactorily and entirely, it were requisite that we should discover the cause of these events,—an enterprise involving difficulties of a very different nature."

In short, the first post-Linnæan phase of the evolving Creation Theory is on the whole, still Biblical. The Flood is highly important; the revolutions are few, and no more than can be fitted to the Genesis account. The single creation center is assumed to be the Garden of Eden. Cuvier does not discuss these points. Everybody in his day took them for granted.

There remains the problem of the creation of man. Up to about Cuvier's time no such problem, purely scientific, could arise. There is the Bible account, which though it does not directly say that man is the latest of created things, does mention man last in the story of the last day, and may fairly be understood really to have the meaning traditionally given it.

That Biblical account can not be tested against the record of the rocks, until the record of the rocks has itself been made out, at least far enough so that a deposit with human remains in it can be set where it belongs in the geological column: and for that, the world had waited for Smith and Cuvier.

In addition, it proved curiously difficult to identify human remains, elephant bones in particular easily passing for human, since both of us, except for our heads, are among the least specialized of the larger mammals.

In 1577, near Lucerne, the wind blew down a large oak, and revealed underneath, evidently in the glacial drift, the remains of a fair-sized elephant. The city council forthwith transmitted these reliques to a local physician, who determined the bones to be human, and calculated the height of their first possessor to have been some nineteen feet. So the City of Lucerne, highly impressed, adopted two giants as supporters for its coat of arms. Increase Mather, who was president of Harvard College and died in 1725, sent home to the old country the bones of a local elephant out of the local drift to witness antediluvian giants in Massachusetts.

In 1726, another physician, Scheuchzer, described from the Lake Constance district, a skeleton in slate, *"L'Homme Témoin du Deluge,"* concerning which he declared: "It is not to be refuted, here is the half, or nearly the whole of the skeleton of a man, even the substance of the bones . . . incorporated with the stone. In short, it is one of the rarest relics we possess of that cursed race which was buried under the waters"; and the fossil-bearing slab, for a hundred years, until Cuvier set eye on it, was universally acclaimed as proof of Holy Writ.

For Cuvier was the first really competent anatomist that ever sorted out mammalian fossils. It is an old tale that

> ". . . Huxley from one unknown bone could make
> An unknown beast. . . ."

and the story has been passed along from one savant to another as each attracts the public eye.

But Cuvier was the man who really invented the performance. He used to take a block of limestone just as the quarryman had sent it in, with only the bit of bone showing that first caught the workman's eye; and assembling his admirers—and rivals—would exhibit the block and the protruding fragment. Then he would picture the entire skeleton, yet unseen, bone by bone, in complete detail. Last of all, the laboratory technician chipped out the fossil. *Nunc plaudite!* No wonder, when Cuvier spoke, the world took notice.

Cuvier, in 1811, turned the same trick with *Homo diluvii testis.* He brought together his committee of experts and others. He stood by with detailed drawings of living amphibia, and declared the Human Witness of the Deluge to be a gigantic salamander till that moment unknown to science. Then he chipped away the slate. It was!

So little, before Cuvier's day, did men know about their own bones!

The matter really was important. For the first time in the history of science, any fair-sized fragment of human bone could be spotted certainly as human, and nothing non-human could be passed off as man. With strata, in addition, now at last dated geologically, it became for the first time possible to say with any sort of certainty when man first appeared in the geologic column.

On this point, Cuvier was both clear and correct. ". . . in peat depositions or turf bogs, and in alluvial formations, as well as in ancient burying-grounds, the bones of men with those of horses, and other ordinary existing species of animals, may readily enough be found; but amongst the fossil *paleotheria*, the elephants, the rhinoceroses, etc., the smallest fragment of human bone has never been detected. Most of the labourers in the gypsum quarries about Paris are firmly persuaded that the bones they contain are in a great part human: but after having seen and carefully examined many thousands of these bones, I may safely affirm that not a single fragment of them has ever belonged to our species."

We know nowadays, of course, the difference between the glacial deposits that belong to the Pleistocene and the recent ones of neolithic times and later; and we rely more on human artifacts for tracing mankind than on human bones. But Cuvier's proof that alleged human remains are not human, and that man does not occur fossil along with most other beings supposed to have been drowned in the Great Deluge really disposed finally of the Flood of Noah as any notable part of geologic history. Animals had, indeed, perished in some vast catastrophe. But if no human beings perished along with them, then that catastrophe was not in Noah's time. Thus develops the last phase of the Flood Theory in which only the loose surface deposits, the river deltas and flood-plains, and the washed drift, are diluvial, together with the cave deposits which Buckland began to study in Cuvier's old age.

In a word, Linnæanism grows into the primitive Catastrophism of Cuvier simply by adding several diluvial catastrophes and their results. Cuvier's creation doctrine is essentially a theory of multiple floods.

CHAPTER XII

CREATION BY CATASTROPHE

CUVIER'S general theory of wide-spread destructions of life more or less periodic, had hardly been more than fairly set forth by its author, before this, in its turn, began to break down under new evidence from fossil remains.

Evidently, we can, on the one hand, prove that certain species are now extinct; because the argument from ignorance will not hold for a score of species the size of present-day elephants. If such creatures have never been seen, then they are not alive. But, on the other hand, the argument also cuts the other way. If such conspicuous creatures were alive during the Paleozoic and Mesozoic Ages, then we should somewhere or other find their bones before the Tertiary rocks were laid down. Furthermore, the extinct elephants themselves, with their fellows the mastodons, are all late Tertiary or Pleistocene. If they date from the first creation, why do they not occur in the Paris Basin and elsewhere, along with the abundant fossils of other large land mammals in the middle and lower Tertiary? It all looks very much as if there were no large mammals anywhere until the Tertiary began, and no elephants and mastodons until the Tertiary was nearly over. All this hits hard the third form of the Creation Theory that makes all creatures now living date back to the beginning of their kind. There must have been a series of secondary creations subsequent to the original one.

There is still another objection to this Migration Theory of Cuvier. Life is assumed to have been destroyed over such large areas that whole groups of species were wiped out. But the operation of wiping out a group of species is always a little too neatly done. As information accumulates, it appears that the catastrophe that puts an end to a species, always does so thorough a job, that when the new group of animals comes in to fill the vacancy, none of the old ever comes with it.

There are thousands of cases known, where a species becomes extinct locally, and is replaced by another much like it. Virtually never does it happen that the first species comes back to its old location.

But if every species that becomes extinct is so thoroughly taken care of by the supposed catastrophe that it never recovers itself to appear anywhere else on earth, then the catastrophes that blot out creatures so thoroughly must be virtually world-wide. But if they are virtually world-wide, then they must dispose of everything on land when they affect the land, or in the sea when they affect that. Where then are the animals from the other district that are to make their way into the devastated earth and repeople it?

In other words, the general rule that a species, once extinct, does not reappear, points to world-wide catastrophes, not to local ones. But world-wide catastrophes leave no creatures to migrate. Therefore, must the renewal of life, at least in large areas, be always by re-creation, not by immigration.

Here then, in outline, is yet a fourth Creation Theory, the inevitable development from the third, as that from the second. There was no single first creation, from which all species that we know alive have survived through. On the contrary, there have been several creations, perhaps many. The world goes on for a geologic age quietly enough, about as, on the Linnæan theory, it goes on for the whole of geologic time. Then comes the great smash and everything is blotted out, no Ark saving any remnant, and nothing managing to survive in some out-of-the-way corner of earth. Then comes the new creation, everything commenced afresh

Wie am ersten Tag.

This is the Catastrophic Geology, which starts with Cuvier and grows by stages more and more catastrophic till it culminates in Louis Agassiz. To the elder

Agassiz, therefore, one turns for the last stage in a procession in which Cuvier took the first step.

Agassiz was the last great naturalist to believe in Special Creation. Virchow, to be sure, was fifteen years the younger man, and outlived Agassiz by thirty. But Virchow was a pathologist and a laboratory man, not an outdoor worker as was Agassiz. No one, at least no scientific person, could attack organic evolution more fiercely than Virchow, but he took his ammunition mostly at second hand; and Agassiz is properly the last of the Creationists.

Yet Agassiz's form of the creation hypothesis was not the last that it took before it finally broke down. He was a Swiss, and brought up in Cuvier's sphere of influence. He was, besides, by nature, curiously conservative in spots; and he was, in philosophy, a follower of Plato, a most uncommon discipleship for a man of science. Altogether, then, Agassiz, in opinion, belongs next to Cuvier, and before Lyell in his first period, instead of after Lyell, though he was by ten years the younger man in birth.

Even so, Agassiz had traveled a long way from the crude and Biblical Creationism of Linné or even of Cuvier. He is indeed, in a sense, a disciple of both; but he is always the young disciple in Cuvier's old age, advocating frankly opinions that Cuvier but suspected might be true. Agassiz's most philosophical work, *An Essay on Classification,* appeared in 1859, the very same year with Darwin's *Origin of Species.* But Agassiz, on all theoretical questions, was so inherently a conservative, that his opinions really belong, historically, to the period almost exactly a century ago. His, in short, are the views which any Linnæan Creationist must of necessity adopt under pressure of the rapidly accumulating knowledge concerning fossil creatures of which Cuvier himself laid the sure foundation. With Agassiz, the misgivings of Ray's correspondent and the certainties of William Smith went forward to their inevitable end.

Agassiz, to begin with, ignores Noah. He was himself the originator and in this country the conspicuous advocate of the Glacial Theory. For him, therefore, all the evidences for the Great Flood, from river gravels high in the hills and sea shells in the drift, that for nearly a century had been taken to prove the truth of the Bible, found themselves shifted back into the late Pleistocene, and assigned to the closing stages of the last Ice Age. Nowadays, of course, we can date the whole affair pretty accurately, by simply counting the annual layers in the water-deposited clays, as one gets the age of a tree by counting its annual rings. But in the early days of the Glacial Theory, there was only such time evidence as the Niagara Gorge; and Agassiz knew only that the end of the Ice Age is a great deal too far back in the past to connect with Noah's experiences. So the Deluge, early in the nineteenth century, has shifted from a geological agent to a pious opinion.

In the second place, for Agassiz, James Usher, Archbishop of Armagh, has also vanished from geologic ken. Agassiz, indeed, essays no complete estimate of geologic time; but in discussing the geology of Florida, which is mostly coral reef, late Tertiary, and one of the newest land areas of earth, he argues that "if a width of five miles is a fair average for one coral reef, growing under the circumstances under which the concentric reefs of Florida are seen now to follow one another, and this regular succession extends only as far north as Lake Ogeechobee, for two degrees of latitude, this would give about two hundred thousand years for the period of time which was necessary for that part of the peninsula of Florida which lies south of Lake Ogeechobee to rise to its present southern extent above the level of the sea. . . ." Along with other advances of science in the early nineteenth century, geologic time lengthened enormously.

For all this, Agassiz's creationism is most thoroughgoing. The passage quoted continues with an argument to prove that the sea creatures of the Gulf of Mexico have not altered at all in twice two hundred thousand years. In general terms, however, the traditional six thousand years since the beginning has become nearer sixty million.

It has already been pointed out that even Cuvier, at the beginnings of paleontology, had to face the question whether all the first created species have lasted through; or whether some, perhaps many, have become extinct. Cuvier, unearthing from the strata of the Paris Basin a group of primitive ungulates of which *Anoplotherium* is perhaps the most familiar, argued his case on these alone. By Agassiz's day, the world was much better known, the blank places on the map were already pretty small, and the possibility of any sort of fair-sized creature continuing unknown had become almost negligible. At the same time, the number of lost species had greatly increased, with Agassiz's own work on fossil fishes on the whole the most noteworthy contribution to the evidence. It simply was not thinkable that science was missing all these creatures, either in the present-day world in the flesh, or as fossils in the rocks, earlier or later than the place in the geological column where they chance to be first seen. So Agassiz swung to the other extreme of opinion from Cuvier, and maintained that vast numbers of species have become extinct since the beginning. In fact, he went so far as to insist that no species whatever, now alive, has survived through from the original creation.

Necessarily, then, since there are still animals on earth, all the creatures that we know in the flesh must have been created sometime after the first set. The question it: When? And there is also the question: How many times has destruction and re-creation occurred during the long eons of geologic time?

On both these problems, Agassiz held very definite views. For him, as Huxley has said, geologic history was like a succession of rubbers of whist, where, at the end of each, the players upset the table and tear up the cards.

Meanwhile, a great geologist, Elie de Beaumont, of the Paris School of Mines, had been developing a theory of mountain building and mountain systems that remained orthodox geology until well past the middle of the century, and influenced decidedly the whole Catastrophic Creationism. Cuvier, Agassiz, and de Beaumont were all personal friends, and the two anatomists, wherever their opinions touched the other science, took over bodily de Beaumont's views. So it happened, Agassiz's and Cuvier's fossils, and de Beaumont's *Systèmes de Montagnes* fitted one another, hand and glove.

"We observe," writes de Beaumont, "when we attentively examine nearly all mountain-chains, that the most recent rocks extend horizontally up to the foot of such chains, as we should expect would be the case if they were deposited in seas or lakes, of which these mountains have partly formed the shores; whilst the other sedimentary beds, tilted up, and more or less contorted, on the flanks of the mountains, rise in certain points even to their highest crests."

In other words, there was once a flat sea floor on which rock strata were laid down horizontally. Then that sea floor rose up into a mountain chain, that formed the shore of another sea. In that new sea, new strata form, also horizontal. And because by de Beaumont's time, strata can be dated by their fossils, we know that that particular mountain chain rose up out of the sea, after the age of the first fossils and before the age of the second.

The reasoning is sound and the facts are as stated. But the facts turn out to be vastly more complex than de Beaumont supposed, so that he generalized from too small data and made a theory that turns out to be much too simple. His general notion of the earth is that of Burnet, a cooled and solid crust, comparable in thickness to the shell of an egg, surrounding a hot and liquid interior; but in place of Burnet's single breaking up to make Noah's Deluge, the cooling globe gradually accumulates strains and then yields suddenly. So the earth remains quiet for a geologic age, and rock strata with their contained fossils form on the sea floor. Then the crust buckles suddenly, and a set of mountain ranges, all parallel, form at the same time in different parts of the earth, "*à un seul jet.*" Thus, to continue de Beaumont's own words, ". . . in the history of the earth there have been long periods of comparative repose, during which the deposition of sedimentary matter has gone on in regular continuity; and there have also been short periods of paroxysmal violence, during which that continuity was broken." Naturally, these paroxysms of the globe of early nineteenth century geology are also the catastrophes of the paleontology of the same period.

De Beaumont saw correctly that the last upheaval of the Alps is no older than middle Tertiary; and that the Andes are, in part, still younger. He held, in addition, that the elevation of the Andes caused all the nearly three hundred active volcanoes of earth, and that the resulting agitation of the ocean water became the transient Deluge of Noah. In all, he made twelve of these great revolutions. Late in life he modified his views in the direction of more numerous and less violent catastrophes, seeing that the Pyrenees alone, by his own test, must have gone up by six or seven separate jumps. Up to the middle of the century, however, about a dozen profound revolutions was the prevailing doctrine, with a corresponding general destruction and re-creation of all that lives.

Agassiz, then, following de Beaumont, held to a theory of successive short and violent periods of mountain building, succeeding long and quiet ages, that over and over again, certainly a dozen or fifteen times, possibly even fifty or a hundred times, absolutely wiped out every living thing over vast areas. Then, after the convulsion is over, and nature has once more quieted down, the Almighty again takes a hand, and creates anew a full set of animals and plants to repeople the desolated earth.

In Agassiz's own words, from the *Essay on Classification:* "Species are truly limited in time, as they are limited in space, upon the surface of the globe. The facts do not exhibit a gradual disappearance of a limited number of species, and an equally gradual introduction of an equally limited number of new ones; but, on the contrary, the simultaneous creation and the simultaneous destruction of entire faunæ, and a coincidence between these changes in the organic world and the great physical changes our earth has undergone." In effect, then, ". . . . the general results of geology proper and of paleontology concur in the main to prove, that, while the globe has been at repeated intervals, and indeed frequently, though after immensely long periods, altered and altered again, until it has assumed its present condition, so also have animals and plants, living upon its surface, been again and again extinguished and replaced by others, until those now living were called into existence, with man at their head. . . . Here, again, the intervention of a Creator is displayed in the most striking manner, in every stage of the history of the world."

Still, one would hardly say that there is displayed in this system of Agassiz's any striking agreement with the account in Genesis. Agassiz is so sure that nothing whatever was created once for all, that even when a species appears, apparently unchanged, on two sides of one of his great catastrophes, he still insists that the earlier form was blotted out; and then, in the succeeding geologic age, another, just like it, was created as if at the beginning.

Presumably, each time, "God saw everything that he had made, and, behold, it was very good." But each separate creation might well have thought:

"If I so very soon am done for,
I wonder what I was begun for?"

Nor had Agassiz any better liking for the traditional picture—not, to be sure, really founded on Genesis—of the single pair of each species, commanded to be fruitful and multiply, and the lion, before the Fall, eating straw like the ox. On the contrary, in Agassiz's own words, "Pines have originated in forests, heaths in heaths, grasses in prairies, bees in hives, herrings in shoals, buffaloes in herds, and men in nations;" and he evidently has always in the back of his mind the idea of a Creator deliberately arranging in advance for assemblage of animals and plants, in just such numbers, and with just such life-spans and mutual edibilities, as shall balance and supplement one another, to give each creature its meat in due season, its shelter, and its chance of life. "The combination in time and space of all these thoughtful conceptions exhibits not only thought, it shows also premeditation, power, wisdom, greatness, prescience, omniscence, providence." It does not, however, obviously suggest a Being who formed out of the ground every beast of the field "and brought them unto the man to see what he would call them."

In fact, Agassiz has quite forgotten that there ever was any Garden eastward in Eden, or any spot anywhere on earth where all living beings were created and from which they dispersed to the ends of all the earth.

"It was a great progress in our science," writes Agassiz, "when the more extensive and precise knowledge of the geographical distribution of organized beings forced upon its cultivators the conviction, that neither animals nor plants could have originated upon one and the same spot upon the surface of the earth, and thence have spread more and more widely until the whole globe became inhabited. . . . For now that we have the facts of the case before us, it is difficult to conceive how, by assuming such a gradual dissemination from one spot, the diversity which exists in every part of the globe could ever have seemed to be explained. But, even to grant distinct centers of distribution for each species, within their natural boundaries, is only to meet the facts half way, as there are innumerable relations between the animals and plants found everywhere associated together, which must be considered as primitive, and can not be the result of successive adaptation. And if this be so, it would follow that all animals and plants have occupied, from the beginning, those natural boundaries within which they stand to one another in such harmonious relations."

In other words, each time the world is re-created after its score or two of destructions, everything in it comes at once; and if there are identical creatures living at the same time on opposite sides of sea or mountain range or other impassable barrier to their migration, then it follows that the two sections of the species were created independently, each in its own spot. In short, writes Agassiz, "I say that facts lead, step by step, to the inference, that such birds as the Mallard and the Scaup originated simultaneously and separately in Europe and America; and that all animals originated in vast numbers, indeed, in the average number characteristic of their species, over the whole of their geographical areas, whether its surface be continuous, or disconnected by sea, lakes or rivers, or by differences of level above the sea, etc."

Strange it is that Agassiz, the one man to be most quoted nowadays in opposition to organic evolution, should really have been the leading spokesman for that theory of animal origins which more than all others, evolutionary and non-evolutionary alike, most flatly contradicts at every point, the account in Genesis!

Moreover, though Agassiz was, on the whole, the most thoroughgoing creationist that has ever studied natural history, he was along with it, a good deal of an evolutionist as well.

Agassiz believed that species are created separately; and Agassiz also presupposed more separate large-scale creative acts than any other man who has ever lived. At the same time, he believed in a pretty general improvement of creatures as successive creative acts replaced good by better. The matter, he held, is vastly complex and some essential facts are still to come. "Yet, through all these intricate relations there runs an evident tendency toward the production of higher and higher types, until at last, Man crowns the whole series. Seen, as it were, at a distance, so that the mind can take a general survey of the whole, and perceive the connection of the successive steps, without being bewildered by the details, such a series appears like the development of a great conception, expressed in proportions so harmonious that every link appears necessary to the full comprehension of its meaning, and yet so independent and perfect in itself, that it might be mistaken for a complete whole, and again so intimately connected with the preceding and following members of the series, that one might be viewed as flowing out of the other. . . . Who can look upon such a series, coinciding to such an extent, and not read in them the successive manifestations of a thought, expressed at different times in forms ever new, and yet tending to the same end, onward to the coming of Man, whose advent is already prophesied in the first appearance of the earliest Fishes!"

There speaks Agassiz the Platonist! Agassiz is, historically, the last Creationist. But Agassiz of this passage is also and in equal measure the forerunner of Darwin and the *Origin.*

For Agassiz, along with his thoroughgoing catastrophism, had no small part in developing yet another side of the general theory of the origin of species by special creation. By his time, the ideas concerning the relation and the content of the greater groups of the animal kingdom which Cuvier had laid down, had so far established themselves, that the order in which these several groups appear in geologic time became at last significant. So long as the tracks of dinosaurs are taken for those of birds, so long as amphibians and reptiles remain undistinguished, so long as a modern "bony" fish and an armored ganoid with no internal bony skeleton are lumped together as "fishes," the order in which these creatures turn up in the rock series is no great matter. There is no plot nor progress to the geological story.

But the classification once straightened out and the order of succession proved, then at last, the story takes on meaning. Then for the first time it appears that, from the beginning, the world has moved.

There are no fishes known fossil at the bottom of the Paleozoic, but only invertebrates. The first fishes are primitive, quite unlike the types that most of us know. After these, in the Coal Period, follow on the amphibia; and next to them the reptiles. The birds are a side branch, but even here the toothed birds are earlier than the modern sorts, as the higher fishes are later than the ganoids. Last of all come the mammals and man. But among the mammals, which are fundamentally land creatures, the seals and whales and bats are later than the proper quadrupeds, as the water-dwelling and the flying dinosaurs before them were later than the land reptiles.

So there is a real progress from simple to complex, from low to high, from fish to man. Species are created; but they are not created haphazard. Each fits into a scheme of things. Each suggests a plan carried out that far, and to be carried along another step by and by. This Agassiz saw sooner and more clearly than any other man so well acquainted with the evidence. For him there are catastrophes, indeed, many and unsparing. But after each, a higher creation replaces a lower on earth.

Here, then, is the developed Catastrophism as contrasted with the primitive Catastrophism of Cuvier. Its essential features are creation by full numbers, not by pairs; creation in the district, instead of dispersion from any Eden; and an orderly progress of successive creations throughout geologic time. This is the most elaborate and complex of all Creation Theories. That most persons who held it supposed it to be set forth in the initial chapter of their sacred book, exhibits yet again the remarkable flexibility of the Hebrew tongue.

CHAPTER XIII

THE UNIFORMITARIAN GEOLOGY AND ITS RESULTS

LINNÆANISM and paleontology do not go together. So long as men know only their local plants and animals and their local rocks they can hold to the simple and Biblical doctrine that makes all species appear on earth at one place and time and last through. But once let men take to studying fossils systematically, and they are bound to discover first, with Cuvier, that all species have not lasted through, then that few or none now on earth go back to the beginning, and finally that there have been many different creations along with the single one narrated in Genesis. That much becomes fixed beyond question by the first quarter of the nineteenth century. Geology is older far than paleontology. The essentially "static" Linnæanism gives way to a much more complex and interesting view of the world as soon as the sister science to geology becomes adult.

Successive creations are, then, proved. That the creations follow world-wide catastrophes is only an inference from a rather narrow range of facts; because the only regions of earth at all well known are the western side of the European continent and the British Isles, which chance to be a region of rather uncommonly violent behavior on the part of the earth. The idea that creation is in quantity rather than by pairs is an inference from the inference, logical indeed but quite without foundation if there were after all no catastrophes. The next step in the evolution of Creation Theory took place therefore by way of the developing science of geology, as the world became more widely and more accurately known.

Up to about 1835 men held pretty generally to the set of opinions of which Agassiz is here spokesman. Geologic history is the story of catastrophes and destructions. Animal and plant species, by the ten thousand, have been created, only to be wiped off the earth, with only a few shells and teeth and skeletons to show for their million years of existence.

Meanwhile, however, quite another set of ideas has been taking shape.

Hutton, a Scot of Edinburgh, gathering together a good many scattered threads of geological observation, but relying most of all on his own first-hand knowledge of British strata, brought out in 1788 his *Theory of the Earth*, and again in a larger book, in 1795, developed still further the same ideas. His was a highly revolutionary opinion. There are, he argued, nowhere on earth any rocks that date back to the creation, nor indeed any that do not bear the certain record of still older rocks from which they have been slowly formed. Even the granites, which in his time had been taken to be the original crust of the world, anterior to all living things, he proved from field studies in the Grampian Hills, to be younger than schists and limestones over them, because the granite sends out branching dikes into the overlying strata, as it could not do if it had not come in melted, after the other rocks had formed. "In the economy of the world," he wrote, "I can find no traces of a beginning and no prospect of an end."

This opinion of Hutton's, commonplace of every schoolbook as it has since become, was by no means well received in Hutton's day; for it pushed back the beginnings of geologic time far beyond anything before imagined, and made still more difficult the reconciliation of Genesis and geology. All geologists of that time were in bad odor with the Church; for, as even the amiable Cowper permitted himself to say, they

> ". . . drill and bore
> The solid earth, and from the strata there
> Extract a register, by which we learn
> That He who made it, and revealed its date
> To Moses, was mistaken in its age."

But Hutton had the facts on his side. The Geological Society of London was founded in 1807, and its members forthwith set themselves to accumulating evidence, eschewing all speculation and all such "theories of the earth" as had occupied the minds of cosmologists since Babylonian days. In short, geology, for the first time in history, cut loose from theology and cosmology alike, and became a real science.

The result was the gradual collapse of the whole idea of catastrophes anywhere. The world came to be thought of as always being about what it is now. The little brooks run muddy in the spring, and in the course of time wear down the mountains. The mountains, in their turn, rise up—rapidly, to be sure, as geologic time goes, but never so fast that a human being living on one of them would notice anything especially unusual, nor any faster than the Andes, for example, have been rising since the discovery of America.

Inevitably, with this trend toward uniformitarianism, the gaps in the history of life tended to be less dwelt upon. As more and more fossil species became known, more and more were seen to have survived from one geological period to the next, in happy ignorance of the great catastrophe that should have blotted them out. Moreover, as other parts of the world than France, Germany, Italy, and the British Isles came to be studied in detail, especially after James Hall's work on the New York rocks, it became clear that the great uncomformities which seem to mark off Silurian from Devonian time, and Devonian from Carboniferous, are only local and British. The New York strata run straight through the entire Paleozoic, with no such interruptions anywhere as have given in Great Britain the main divisions of geologic time. Earth history proves to be like human: the Middle Ages changed into modern times—but nobody who was alive during the transition noticed that anything unusual was going on.

Furthermore, as information grew, it began to appear that the geologic ages, as fixed by the life that marks them, will have to be set off from one another less by any real alterations than by the particular set of organisms that one chooses to make the test. Our Mesozoic-Cenozoic division, for example, is made conventionally between the extinction of the dinosaurs and the rise of the placental mammals. That is because fewer people are interested in plants than in animals; because the dinosaurs were most remarkable creatures in themselves; and because the mammals concern us as ourselves mammalian. But the great break in the vegetable world comes between the lower plants, up through the needle-bearing "evergreens"—which really, there being no proper English term, one might as well learn to call Gymnosperms—and the broad-leaved plants, mostly deciduous where there is a winter, the Angiosperms. If, therefore, the present-day divisions of geologic time had chanced to have been made by a botanist, the Cretaceous would have been put in the later instead of the earlier geologic age. The higher plants take their rise before the higher animals. The world had taken on its present-day vegetation while its animals belonged to a long-distant past. In short, the divisions of geologic time once more turn out to be like the divisions of human history. We westerners date epochs from the fall of Rome and the discovery of America. A Chinese historian knows nothing of any such.

All this took time. Science was still a good deal the handmaid of theology and few indeed were the scientific persons who found it wise to push to the limit the obvious conclusions from their facts. There is, moreover, an alternative of a curious sort between the catastrophic and the uniformitarian geology. For catastrophes, one must speed up enormously the known processes of nature. Then one can suppose mountain chains to rise up and continents to sink as suddenly and as catastrophically as one likes. On the other hand, if nature is uniform, and the familiar processes of nature are not to be speeded up much beyond their present-day gait, then is geologic time enormously long. One can account for most facts of observation either by augmenting activity or by augmenting time.

But human nature takes to any sort of marvel, ever ready to imagine more. Human nature does not like to imagine long periods and slow motions. Moreover, there is always the ghost of Archbishop Usher. Men granted that a day of the Lord is a thousand years: they resisted making it two thousand. Geology, therefore, granted its long "day," has nevertheless had to fight for each increment to that length.

In addition, Hutton himself had the same misfortune that later overtook Darwin. Both men were extraordinary observers and both were at the same time, what is most unusual, acute and critical reasoners from their facts. Both came to their abundant data with a fresh eye, and concerned themselves little with the mass of prejudgment that had grown up with the long years before their day. Both, in addition, were quite without skill in presenting their ideas, and both were much too single-minded to ease off their opinions in the face of a hostile world. The result was inevitable. Nobody actually read Hutton's *Theory of the Earth*, in the eighteenth century, just as nobody actually reads Darwin's *Origin of Species* in the twentieth. People attack Darwin now in blissful ignorance of what he actually wrote. The same sort of people in Hutton's time attacked him on the same basis.

Hutton, in short, though the real founder of modern scientific geology, not unlike Darwin, "buried his reputation under the weight of material which he left to support it," so that our present-day, purely scientific, geology is conventionally taken to date from the printing of the first edition of Sir Charles Lyell's *Principles,* in 1830. His was a charmingly written book, skilful and sober and cautious and clear-headed. It quite supplanted Cuvier's *Theory* as the one great popular account of the earth's past; and it went through eleven editions—the last in 1872, three years before the author's death. Meanwhile its author's views were influencing profoundly all geologic theory, until in the end, the whole scientific world came round to Lyell's opinions. Of all books that British science has brought forth, only the *Principia* and the *Origin,* have outweighed this.

Lyell, it is well known, was one of the first eminent persons to become a convert to "Darwinism" and that almost at once after he read the *Origin.* Before that time, he believed in Special Creation, as nearly all naturalists of his day were doing. But his Creationism was of quite the opposite sort from Agassiz's.

Lyell, of course, held that there are no real breaks in the continuity of geologic history. Animal and plant species have, indeed, come and gone, many times over. This the record of the rocks proves abundantly. But there have been no special times of extinction and re-creation. "The mystery in which the origin of each species was involved," wrote Lyell in his old age, looking back on his own youth and the first edition of his book, "seemed to me no greater than that in which the beginning of all vital phenomena on the earth is shrouded. But I undertook to show that the gradual extinction of species one after another was part of the constant and regular course of nature, and must have been so throughout all geologic time, because the climate, and the position of land and sea, and all the principal conditions of the organic and inorganic world, are always, and have been always, undergoing change. I pointed out how the struggle for existence among species, and the increase and spread of some of them, must tend to the extermination of others; and as these would disappear gradually and singly from the scene, I suggested that probably the coming in of new species would in like manner be successive, and that there was no geological sanction for the favorite doctrine of some theorists, that large assemblages of new forms had been ushered in at once to compensate for the sudden removal of many others from the scene."

Lyell then went on to meet the objection, that if species are all the while being created newly, some naturalist, at least in the long settled and thoroughly explored parts of Europe, ought to catch the Creator in the act of creating. This is, be it observed, precisely the argument that is to-day used against the Evolutionist, who is called upon vociferously to produce his species evolving. In Lyell's time the argument cut the other way, against the most reasonable of all creationist theories.

Lyell made the same answer that every Evolutionist makes now—time is of the essence of the problem. Lyell showed by an ingenious calculation, that all the facts presupposed by his doctrine are accounted for if a new mammalian species appears in each area the size of Europe once in forty thousand years.

Lyell, moreover, does not agree with Agassiz, that creation is by vast numbers of individuals simultaneously; but does agree with Linné that creation goes by single pairs. Thus Lyell, in a way, marks a return from the extreme anti-Biblical opinions of Agassiz and his group, to something much more compatible with Genesis. But Lyell holds to multiple centers of creation; for by his day, the progress of biologic exploration had made any other view impossible.

But amid all this theorizing there was always one practical question that would not down: What is a "species"?

Linné, living in an old country where the animals and plants had settled down long since into equilibrium with each other and man, had an easy answer. Linné, moreover, had not to bother with fossil species, nor with that minute study of problematical sea creatures with which Haeckel, for example, was especially concerned; for all this, on any scale, was still far away. Linné, therefore, could say with decent reason, "We reckon just so many species as there were forms created in the beginning." But, practically, even in his time, there was no objective test by which any two zoölogists or botanists could ever certainly agree as to just which modern groups were or were not the descendants of the same original pair.

When Agassiz's turn came, and the world became skeptical as to whether there ever was any original pair of anything, the problem became still more acute. Given a million individuals, created all at once, who knows how much alike they were? In fact, almost as soon as men took to "making" species after the Linnæan system, they began to separate into "lumpers," "splitters," to set so-and-so's lists over against so-and-so's, and to question one another's most fundamental determination. Theoretically, to be sure, species might exist by act of God, like the Tables of Stone with the Ten Commandments. Practically, even in the eighteenth century, species were like "proper" manners and "correct" spelling, the mere general consensus of such people as were interested in plants and animals, had any sort of manners, or took occasion to spell.

Various persons, therefore, essayed all sorts of definitions of species, none of which has ever suited anybody else. Cuvier, who, whatever he thought not worth saying in public, seems always, in private, to have been skeptical as to there ever having been any single original creation, quite abandons all Linné's idea of the original pair as essential to the definition. For him, "A species comprehends all the individuals which descend from each other, or from a common parentage, and those which resemble them as much as they do each other." From this, historically, the formal definitions of a species become vaguer and vaguer until one of the latest, in our own day, boils down to: A species is an assemblage of plants or animals to which a competent botanist or zoölogist has recently assigned specific rank. So, as it turns out, one of Darwin's great services to science was to explode the idea that a species is anything more than the end term, so far, in a process, with no meaning whatever in nature. Darwin did not explain species so much as evaporate the whole idea.

Thus, then, stood the case for Special Creation, about 1850 and a decade or so earlier. Linnæanism is extinct, and with it has gone any possibility of a theory of creation in the least resembling the Genesis account. However, nobody stops to notice what the Book of Genesis actually says, and any sort of doctrine that includes the word "create" is taken as thoroughly Biblical. Catastrophism of all sorts is going out, and with it the idea of creation of large numbers at once, either of species or of individuals. Uniformitarianism is coming in, and creation is coming to be thought of as a "natural" process, in the sense that it is going on all the while, and therefore no more remarkable than any other of the impenetrable mysteries that surround mankind—the growth, for example, of a blade of grass. Altogether, that most fundamental of all scientific ideas, the Continuity of Nature, is replacing everywhere the medieval belief in discontinuity. In short, the world is reacting from Linné and Agassiz, and going back to Aristotle. The effect, therefore, of the uniformitarian geology on creation theory, was to restore the older idea of the single pair as the unit, in place of the great multitude, and to make creation a continuous and somewhat uniform process that has been going on steadily throughout geologic time.

CHAPTER XIV

THE GEOGRAPHY OF CREATION

THE second quarter of the nineteenth century saw a new science in the natural history group. Those were the days when every ambitious young naturalist betook himself off somewhere on the other side of the world, and made his reputation by getting first chance at a new lot of animals or plants that civilized man had never seen before. Darwin flitted to Patagonia and wrote the *Voyage of the Beagle;* Hooker and Huxley reached Australia; Haeckel, Celon; Dana, the South Pacific; Agassiz tried various wildernesses; Wallace put in four years in the Amazon Valley, and thereafter spent much of his mature life in the Malay Archipelago and thereabouts.

The result was to open up enormous new fields for anatomical study; for nature is lavish, and the ends of the earth have animals and plants notably different from those of Europe and North America. A vastly more important result, for the evolution of Creation Theory, was to found a whole new science, the science of Geographical Distribution, and to turn the great museums of the world from arranging their contents by types mainly, to stressing arrangement by localities. It now becomes important, not merely to know what a creature is like. We must also know where it comes from.

The effect was to repeat in another field Agassiz's experience with the succession of species in time. Agassiz, as we have seen, along with others, had proved that species do not replace one another haphazard throughout the succession of geologic ages. On the contrary, they follow definite systems, so that each species has its place in a time series, and can not go somewhere else instead. In the same fashion, Wallace, along with others, proved that each species fits also into a space series, and can not appear anywhere else on earth except just about in the particular habitat where it actually does appear.

Take, for example, Gulick's work on the snails of Oahu Island of the Hawaiian group, where he spent much of his life as a missionary. Oahu Island, on which is Honolulu, is only about fifty miles across, a new-born land whose rocks are corals and lava flows, two thousand miles away from any continent. Much of its surface is an elaborate set of valleys newly cut into the lava, each of which is occupied by a damp woodland, is separated from its neighbors by a drier ridge, and opens out at its lower end into grass land. Gulick's snails live in the damp woods, mostly in the trees, and they can not cross the dry ridges which separate the valleys nor pass from valley to valley by way of the grass-grown lowlands. Each valley, then, is a closed area, cut off from all the world besides, so long as the climate does not alter.

But each valley has its special sort of tree snail, two hundred separate species on the little island, split into six or seven hundred varieties that are not enough unlike to rank as species! All these two hundred species, moreover, are closely related; and not one of them occurs anywhere else on earth.

They are not distributed over the island at random. On the contrary, neighboring and connected valleys have like sorts; distant or more separated valleys, unlike sorts. The whole arrangement is a consistent pattern. Those two hundred or six hundred centers of origin for those two hundred species or six hundred varieties fit into a plan that Reverend John Gulick spent much of his life in making out.

The same sort of consistent pattern for the distribution of species appears everywhere, without exception, all over the earth, and alike in every group of animals or plants. The humming-birds, to take another example almost at random, are all western and nearly all South American. None originated on the Eastern Continent, and none have reached any part of it by migration. South America is obviously their point of origin, and there are four hundred species of them, of a hundred and twenty genera. Most of the species are very local. One mountain peak has its; the next has another; the peak beyond a third. But like the snails they all make a pattern over the country. It would interrupt the obvious design if two species, a few miles apart, should interchange locations.

Or to take a quite different sort of fact, the old-world apes and monkeys range in character all the way from tiny creatures hardly bigger than a squirrel with tails longer than their bodies, up to gorillas that are three times as large as a man and have no tails at all; and they range in habitat all the way from the equatorial forests of Africa, to the highlands of central Asia, where the snow covers the branches of the trees. But they all have teeth like ours, and they never have prehensile tails.

On the other hand, the South American monkeys also range wide and are of many sorts. But they all have three premolar teeth in place of the old-world two, and they frequently, though not always, swing by their tails.

In other words, a prehensile-tailed monkey or a monkey with three premolar teeth simply does not occur in the Old World, anywhere. The eastern monkeys all have two premolars and their tails, if they have them, are no fifth hand. There, then, is a different pattern for the two sides of the Atlantic, so that no species from one side fits into the scheme of things on the other.

Moreover, this scheme and pattern for the living inhabitants of any region includes also the more recent of the fossil creatures. The sloths, for example, are all now South American. But the gigantic and extinct ground-sloths, like *Megatherium,* are also South American. The gigantic armadillo, *Glyptodon,* of the Pleistocene, is South American. But so also is the little modern sort. The forty-odd species of fossil horses are all from a small region in western United States. As many elephants and mastodons are characteristically North African, midway between the two regions where the two surviving species live now. Cases of this sort might be repeated into the thousands.

Darwin himself, on the Beagle expedition to South America, was about equally impressed, on the one hand, by the complete difference between all the species that he knew at home and those that he collected in Argentine and Patagonia, and on the other hand, by the close resemblance alike of the modern and the extinct species of Great Britain, and of the living South America creatures to those whose bones he turned out of the South American deserts. That really was the starting point of Darwin's interest in organic evolution. He had to explain somehow these characteristic distributions and resemblances. He recognized the consistent time-and-space pattern in the whole animal kingdom throughout all the earth; and he could not but think that the obvious explanation is that present-day species in any spot are like the fossil species there, because the one set has descended from the other: neighboring species of snails or humming-birds are alike because all derive from a common ancestor. Why, he asked himself, in effect: If species are created independently of one another, are there never typical South American species, alive or fossil, in Europe; nor European in South America?

Not Darwin, however, but Wallace, first put the general idea into final shape. Wallace pointed out that almost never does any species, or even any genus, occur in two separate localities without also being found in the intermediate space; while, at the same time, no species and no genus in the geological record has ever come into existence twice, or having once died out been re-created. All this, he formulated in what is called after him, "Wallace's Law": "Every species has come into existence coincident both in space and time with a pre-existing closely allied species."

Species, it appears, then, nearly always go in sets. This island has its special sorts; and that island near by has its. The two are different—it may be that for whole branches of the animal kingdom the two areas will not have a single species in common. And yet the two faunas will be so closely alike, that oftentimes only a trained naturalist can make out that they are not the same. Or again, a volcanic island, newly risen up out of the sea near a continent, will have, for the most part, its own special equipment of animals and plants. But, again, these will be nearly like those of the great land mass near by; and they will always be the sort of creatures that might have got across the intervening sea, blown by the winds or rafted on floating logs or carried in the dried mud on a bird's foot. Indeed, for the most part, the animals and plants of any isolated area are distinctly correlated with the direction of the winds and the run of the sea currents and with the chances of each particular sort of creature's getting across the barrier alive.

Darwin himself made a special study of the animal inhabitants of islands, testing Wallace's Law by the "pre-existing closely allied species" of the nearest larger body of land, and brought to light a great quantity of most curious facts.

For example, an island, geologically new, no matter how large nor how admirably fitted for animal life, does not, in general, contain any mammals except bats, if it is more than three hundred miles from the nearest shore of a continent. Nevertheless, it commonly has abundant birds and land molluscs, like the two hundred land snails of Oahu, along with other small creatures often unique and usually most peculiarly related to those of the nearest greater land mass.

Take by way of illustration the Galapagos group, which Darwin was among the first to study, and which influenced profoundly all his subsequent thinking on the problem of origins. These islands are just under the equator, half a thousand miles westward from South America, volcanic and therefore new. They have fifty-seven species of birds, of which thirty-eight occur nowhere else on earth—but these are all nearly like South American forms. Only one land bird out of thirty-one species is found off the islands. There are, on the other hand, only two species of land-tortoise, with another that is extinct, five lizards and two snakes—all peculiar to the islands, but all of a generally South American sort. The insects are nearly all beetles, thirty-five species, nearly all peculiar. Of three hundred thirty-two species of flowering plants, one hundred seventy-four are unique. But there are no land mammals.

This is a sample of the sort of thing that turns up whenever an island is examined. Each island of a group is a center of origin for peculiar species that appear nowhere else. The group itself is a larger center in which has arisen species common to all the islands but unknown elsewhere. Sometimes, as on

Oahu, even the single parts of one island have their unique creatures. The facts are enormous in number and unquestioned. Every year since Darwin's time has added more.

Obviously, this sort of fact can not be fitted into that fifth form of Creation Theory which adjusts itself nicely enough to Lyell and Uniformitarianism. The general doctrine of a special creation of organic species, as we have already seen, starting with Linné's simple formula, evolved enormously to take in the facts of paleontology by assuming many creations in place of one and many centers of creative activity in place of Eden. The new science of the eighteenth century altered creation doctrine profoundly, but left it whole.

Not so, the new science of the nineteenth century. At the facts of geographical distribution as summed up in Wallace's Law, Creationism, as a scientific theory, broke down. Nobody since the middle of the century has so much as tried to engineer any sixth phase of Creation Theory that shall account for the mutual relations of animal and plant species over the present-day earth and over the other continents and islands that have preceded ours. Given a creation of species that goes on continually, as in Lyell's theory, with each new species almost like another near it or just before, as Wallace proved, any resulting theory of creation must needs be so near to a theory of evolution that there is no more any object in trying to distinguish the two.

There is, then, no foundation for the wide-spread popular impression that Darwin, or Darwin and Wallace, by formulating and applying the principle of natural selection, in any wise founded or caused to prevail our present-day evolutionary account of species. Evolution of our modern sort does not start with Darwin but with Bonnet; and thence marches straight through to Darwin, consistent, inevitable.

For given Bonnet's notion of created germs, everybody must see that the "evolution," in Bonnet's sense, of individual from created germ, is the obvious type and pattern for the "evolution," still in Bonnet's sense, of the whole organic world from its pre-formed and original creative source. So the germ, "evolving" becomes the type and pattern of the world.

But Bonnet's pre-formation breaks down and men learn that there is no evolution in his sense. Evolution, therefore, as a word in the dictionary, hangs in the air with no meaning, and animals and plants arise by epigenesis. But the idea is still in some men's minds of an evolution of the organic world that parallels the epigenesis of the individual. Buffon and Lamarck, along with others, work out this notion. Men become familiar with the evolution, in our modern sense, of the individual as the type and pattern of the greater evolution throughout geologic time.

Catastrophism is a sort of geological epigenesis. The new creations that follow the catastrophes are like the new-formed organs in the embryo. With Agassiz's concept of a great world plan that unfolds itself from age to age, "without haste and without rest," the line between Creation and Evolution has become hazy indeed. Species are indeed created. But the organic world as a whole evolves. With Lyell, the whole process of species-creation has become, in the technical and scientific sense, "natural." That is to say, species-creation is going on all the while and is neither more nor less an incomprehensible "act of God" than everything else ultimately on earth. The origin of species has become only an incident in the progress of life.

Darwin, then, in the *Origin,* merely sprung a mine that Bonnet and Linnæus and Cuvier and Hutton and Lyell and Agassiz, along with a thousand lesser men, had been preparing for more than a hundred years. Just as Cuvier's and Agassiz's notions of the details of creation were certain to supersede Linné's and Lyell's in turn to replace theirs, so inevitably just as soon as civilized governments began to send out vessels charting unknown seas, and to put aboard them such young geniuses as Darwin and Dana and Hooker and Huxley, with Haeckels and Wallaces and Agassizs off on their own explorations, just so soon will a new science, the Science of Geographical Distribution, be born into the sisterhood of natural history. When that is done, no conceivable theory of species origin except "descent with modification" will make the smallest approach to conforming to the known facts. Darwin's work, in detail, was enormously important. His opinions have been enormously influential. In fact, these opinions, disparaged by cleric and philosopher, probably never since he set them forth have bulked larger to the eyes of science than now. The idea of Selection, simply rules all the working natural history sciences from the disease germs of the public health official to the folk migrations of the historian.

Nevertheless, if Darwin had never been born; if the whole notion of selection as the controlling factor in all development everywhere, had never entered a human mind, still would it be inevitable that just about the year 1860, the scientific world would begin to start turning away from all Creation Theories and complete the process in about one decade. There, at least, in one case, was history predestinated.

That the end of Creationism as a scientific doctrine just about matches "the coming of age of the *Origin of Species*" is, after all, only coincidence.

CHAPTER XV

THE REVIVED CREATIONISM

THE history of Creation Doctrines lends itself, in just about the same measure as the rest of history, to separation into periods, of which we may conveniently reckon six.

In the earliest, which we may call, somewhat vaguely, the Biblical Period, there is no science or philosophy in Israel, although a considerable amount of detail of one sort and another has been picked up by contact with Egypt and still more with Babylon, where both science and philosophy have flourished, time out of mind. God, however, at least for the later Biblical authors, is anterior to matter, and the direct cause of all that we now call the operations of nature. But God and nature are not distinguished. God marks the sparrow's fall, and feeds the young ravens which cry. He clothes the grass of the field. He sendeth rain on the just and on the unjust. That whole idea of what we now call, most unfortunately, "Natural Law," is Greek in origin, and quite foreign to the Hebrew mind. Equally foreign to the Hebrew mind, and to medieval Christendom as well, is the whole idea of mechanical causation, the action of "force" on "matter."

Given, then, a strongly religious but quite unscientific national genius, it becomes inevitable that whenever any primitive creation story is retold by a Hebrew, its form of words will be strongly creationist—as, of course, it is in the Genesis narrative. But this creationism is only a literary form. If one could see the hypothetical "Moses" face to face, and ask him whether he meant to describe the earth and its inhabitants as created or evolved, it is highly doubtful whether any of us moderns could make him understand the difference between the two. He would insist with his last breath that whatever happened, God did it. But as to precisely what God did, and by what process, he would most likely profess complete indifference.

Precisely the same problem confronts the unimaginative interpreter of the Bible when he tries to make out from it whether the earth is round or flat. As a form of words, without question, the Bible implies a flat earth; and all theologians who have based their geography on the Bible, have, historically, been flat-earthians. And yet one imagines that various authors of psalm and narrative, if asked flatly what the shape of the earth is, would have to reply, that the problem had never entered their heads at all.

In short, during the Old Testament period in Israel, and apparently throughout the New Testament period also, the problem of plant and animal origins, and of the past history of the cosmos, had simply not arisen.

The second period is that of the Early Church and the ascendency of Plato—by no means adequately interpreted—in church councils.

Neo-Platonism held always that matter is generally inert, and always evil. One of the great problems of philosophy and theology alike, therefore, from the beginnings of Christian thinking down to Augustine's day, was to explain how a good God has created an evil world, and what is the relation of the perfectly good Creator to so very unattractive a creation.

The answer to this problem was: Evolution. All the Gnostic systems—that of Bacilides is a good example—are thoroughly evolutionary. But the evolution is always downward. The good God engenders "sonships" and personified attributes less perfect than himself and more material. These in turn evolve others still more gross, until the last and lowest creates the present world. But there is also the Cosmic Egg, that evolves universes more or less after Bonnet's idea of the development of the chick.

As yet, however, no scientific problem of origins has swum into Christian ken. Nobody has the least interest in animals and plants, except for their magical properties and their moral lessons. The Bible has everywhere a "pneumatical meaning," that is always vastly more important for the believer than anything it actually says.

One recognizes at once in Neo-Platonism and Gnosticism the source of many a present-day theological idea—among them, the doctrine of the Fall. Jewish theology has always ignored this episode in Jewish history; the ancient legend evolved into dogma only in Christendom and under Gnostic influence.

But the Fall was, strictly, an evolution; downward, to be sure, and rapid; but still by definition an evolution, and indeed of quite the type of De Maillet's. In the second period, also, the period of the early Church, evolution and creation are not marked off from one another. Men simply accept both uncritically.

Then, after the Dark Ages—which, after all, turn out to have been not nearly so dark as they used to be painted—came our third period, that of the Schoolmen and the reign of Aristotle. Everybody, therefore, on Aristotle's authority, believes in evolution; and evolution is, in general, upward. Now for the first time, Christendom awakens to a scientific interest in the things of this world, and natural history and medicine begin to split off from magic. The Bible, it goes without saying, is in complete and literal accord with Aristotle, who finds himself, most unexpectedly, quite in the odor of sanctity.

Next came the early modern period, the fourth of our series. Aristotle is out; and the Bible is in. Protestant pastors are required to affirm the literal inspiration of even the vowel points of the Masoretic text; and this text, not translated with any great competence with the lapse of Hebrew scholarship, has become vernacular Bibles, to be interpreted by readers who know no other book.

With this, goes a changed idea of the function of the Bible. Heretofore, the sacred volume has always been interpreted by a Church which had no will to make itself absurd. The Bible, therefore, was understood mostly in a large way, for its main ideas, or for a "pneumatical" meaning, that might be anything under heaven in the world of fact. One did not, of course, dispute either the Bible or the Creeds. But matters of detail, every sort of thing that a scientific person would care about, could be tested by nature and the Greek texts. One must not forget that it was not till after the rise of Protestantism, with its all-explaining Bible, that churchmen took to burning witches in quantity and to bringing scientific men to trial for their opinions. Scientific persons in Roger Bacon's day, suffered for wizardry, not for heresy.

The Bible, in this period, is no longer the somewhat vague revelation to man of such truths as he can not discover for himself; it is the complete revelation of all truth—history, science, theology, alike. It combines "the faith once for all delivered to the saints" with the information once for all delivered to the sinners. What is not set forth in the Bible simply is not true.

Time was when, because the Bible does not flatly say that there are no "new species," the man of science was left free to argue for a "continuous creation." Now, the Bible has told all there is to be known, and if it does not mention new species, then all species are declared to exist from the beginning. So the scientific world had to set forth its theories as mere *jeus d'esprit* or pretend to be translating an Arabic manuscript.

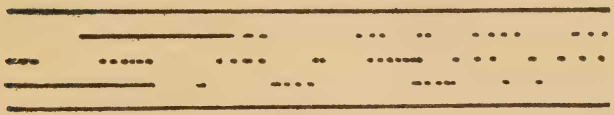
The fifth period, the little more than a century that ended with 1859, was an anarchy. Cuvier, Lamarck, Agassiz, Lyell, and Darwin were all alive at the same time; and the first two lived in Paris. Belief in spontaneous generation had not gone out—Lamarck, among others, clung to it, and Pasteur's work was still far away. Bonnet's Ladder of Being stayed in text-books until after 1830. Evolutionism, though quite out of fashion, never really lapsed—Buffon and Lamarck alone, not to mention a score or two of lesser men, almost close the gap from pre-Linnæan to post-Darwinian time. This was the great period of evolutionary speculation. It was also the single time in history when all four possible creation theories were held by somebody, and when an infallible Scripture was variously interpreted to teach them all.

Meanwhile, Kant in 1750, and after him Laplace, set forth the Nebular Theory, that gave a thoroughgoing evolutionary account of the origin of the solar system and the earth. This, of course, met the usual opposition from the clergy on Biblical grounds. But this opposition proved curiously short-lived. So we have the singular spectacle of Kant and others setting forth an evolutionary theory of the heavenly bodies at just about the time that Linné and others were setting forth a creationist theory of earthly ones; with the learned world, on the whole, accepting both, and for something like half a century believing that the inhabitants of the earth were created, that the earth itself was evolved, and that the Bible supports both views.

Each of these five periods is marked by fundamental change in the opinions of men concerning the origin of the animals and plants which, from day to day, they saw and used. All, in addition, at least in their outcome, were steps in a rather definite evolution of opinion toward present-day views. And since our sixth period, in which we now are, is contributing nothing new to the general theory, but is only a throwback to an older idea, we may well at this point, turn aside to review, briefly, the six possible theories concerning the origin and distribution of present-day life. All six have been held, as we have seen. One should have all six in mind at once, to decide which is correct.

Oldest of all, to express the point graphically, is

Spontaneous Generation

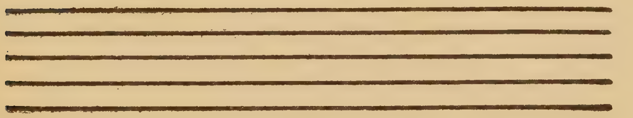


Dots in the diagram are the living creatures. The lines, where there are any, show descent.

In this earliest doctrine, the earth and the waters "brought forth abundantly"—and still do. The vast majority of animals perish without offspring. A few generate others like themselves. The first lot, which the earth or the waters brought forth "in the beginning," are commonly the ones which still reproduce themselves by egg or seed.

With the passing of abiogenesis as a scientific theory, the "spontaneous" dots of the first diagram drop out, and the figure becomes that for

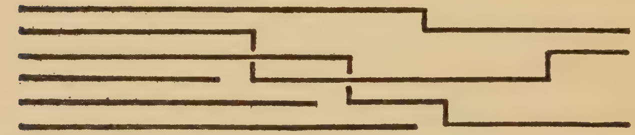
Linnæanism



All species start "scratch"; and all last through to the present day, without much shifting about to different parts of the earth.

This, in turn breaks down, with the scientific proof that the animals of known districts, as revealed by their fossils, have not remained the same throughout known time. Linnæanism, therefore, alters to a doctrine which, because the great Cuvier held it for part of his days, we may well call

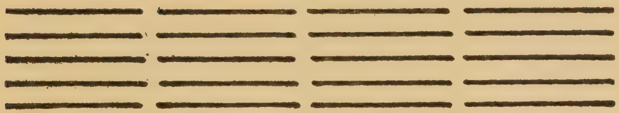
Cuvierism



Here, all animal species are represented as starting at the Creation, but only part as lasting through. More or less periodically, there are such alterations of inanimate nature that, for single districts, life is substantially blotted out, and different species, from other districts, migrate in to fill the gap. So the animals, changing in place, give the impression of altering also in time.

But as evidence piles up to prove vaster alterations more times repeated, "Cuvierism" alters—in Cuvier's own mind as well—to

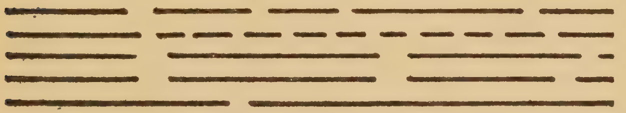
Catastrophism



Here are periodic destructions and re-creations—in short, our Linnæan diagram repeated many times.

But with the progress of knowledge it finally becomes certain that there have been no "catastrophes." Animal species have, indeed, become extinct by myriads, but each in its own time. Some have stuck it out since the Lower Paleozoic. Others drop out from bottom to top of a single cliff, never to reappear. The result is

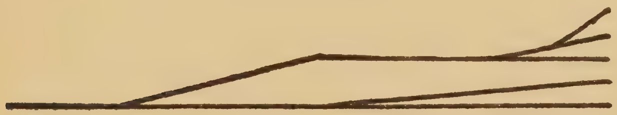
Uniformitarianism



Nature is no longer firing "by volleys" but "at will."

Then came Wallace's Law—fact, not theory—and

Evolution



At most, there are only a few "created" beings.

All known species arise as twigs of an ancestral tree, by "descent with modification."

These six theories of creation-evolution are, in a broad way, all there ever have been. Apparently, in addition, they are all that are logically possible.

Or one could classify a little too simply:

1. Spontaneous Generation, which supposes an infinite number of fresh starting points for organic life.

2. Primitive Special Creationism, which supposes one only.

3. A transition form.

4. Catastrophic Special Creationism which supposes ten to one hundred.

5. Uniformitarian Special Creationism which supposes a million or two.

6. Evolution which involves none.

Last of all comes the sixth period in the history of creation, where we now find ourselves. After a half century, during which the learned world supposed that all creationist doctrine had finally gone the way of the flat earth and the ichthyosaurus, suddenly, without warning, it revives again.

One might, at first glance, suppose that history is again up to its old trick of repeating itself, this time inside out. Creationism, as a strictly scientific theory in zoölogy and botany, came up rather suddenly, lasted a little more than a century, and then somewhat more suddenly, gave way to Evolutionism. One might argue that in these last days, Creationism, after an eclipse of a little less than a century, has again come to its own, and is now about to supplant Evolutionism.

But there is always this essential difference between creation in Linné's time and evolution in Darwin's, and the Creationism of our current history. Both the former were scientific theories, that were maintained on the facts by competent students of the data concerned. The Creationism of the present day is purely a theological dogma, which does not pretend to any scientific standing nor to rest on any scientific evidence, which indeed has never been even stated in such wise that any man of us can make out, flatly and squarely, just what present-day Creationists do or do not believe.

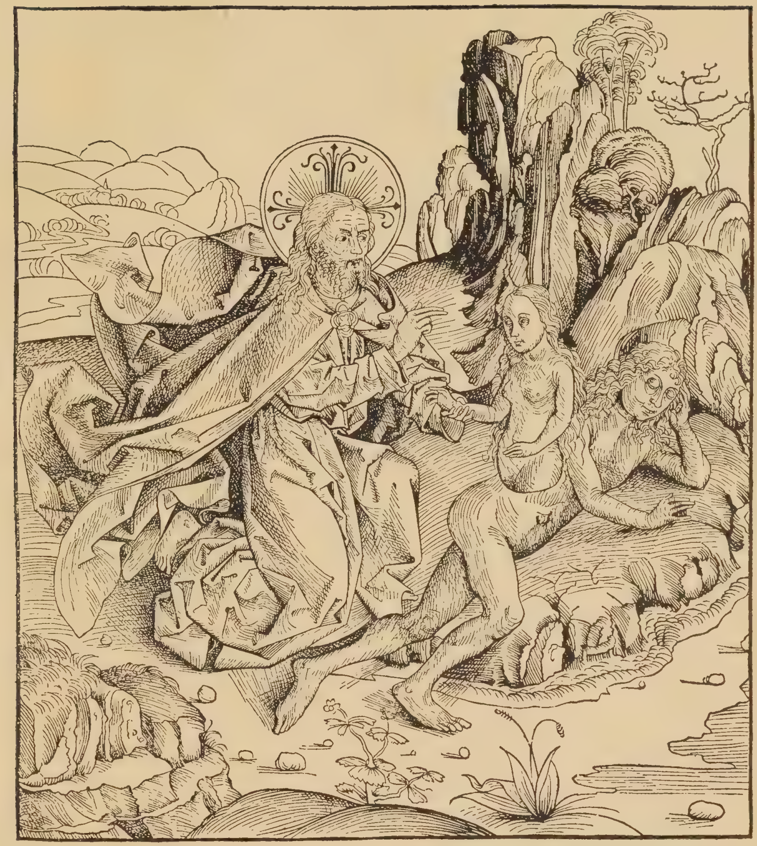
Nevertheless, if one reads between the lines of sermons, especially if one has in mind the historic background of opinion and evidence, there are certain elements and certain tendencies that appear to emerge from the general fog.

To begin with, present-day theological Creationism is, on the whole, Linnæan. Species are the created unit, and the Biblical phrase "after its kind" is taken to mean Linnæan species. At the same time, few theologians have the least idea what a Linnæan species is, so that practically, when they have occasion to illustrate a point of doctrine they use a Linnæan genus instead. Broadly speaking, then, present-day Creationism uses both opinions of Linné as to the unit of creation.

Otherwise also, the current theological doctrine is on strictly Linnæan lines. Creation is by pairs. Dispersion is from the single creation center in Eden. The Flood, however, is more commonly taken to have been less than world-wide. Wright's theory of the Flood as the end of the last Ice Age has a considerable following.

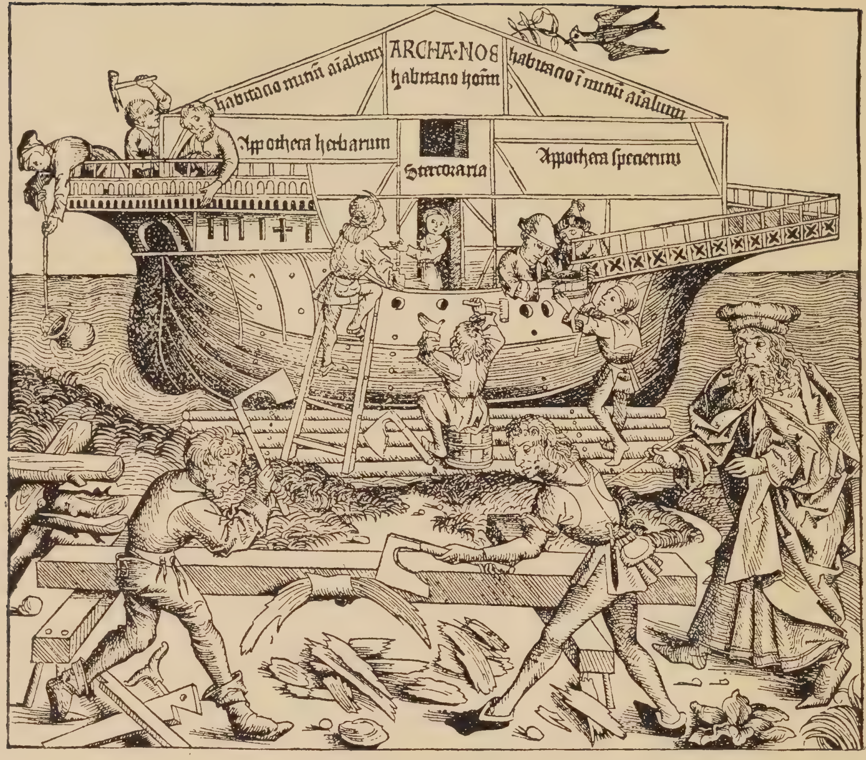
For the most part, opinion follows the "long chronology," with some tendency to make precisely six geologic ages, each precisely one thousand years long. One can, of course, make any number of geologic ages by cutting up a continuous history into that particular number of eras. But the thousand years for each amounts to something less than the tenth of one per cent. of geologic time. One takes up slack by putting in whatever time one needs between the end of the second verse of Genesis and the beginning of the third. Everything is, however, vague; and nobody has thought it worth while to work out any sharp or testable ideas.

On the other hand, one tendency does seem to be taking shape, obscurely indeed, thus far, but with promise of some coherency by and by.



Creation of Eve.

From the *Nuremberg Chronicle*. Courtesy *Harvard College Library.*



NOAH BUILDS AN ARK OF GOPHER WOOD.

The Latin inscriptions are:
Arch of Noe
Habitano of Human Beings
Habitano of tame birds — Habitano of untamed birds
Apotheca for fodder — Apotheca for general stores
Dungheap

From *Nuremberg Chronicle*, 1493. Courtesy *Harvard College Library.*

Opinion appears to be fluctuating between an original pair of each species as Linné supposed during his middle period, and a pair for each genus as Linné was more inclined to believe late in life. But even the most unscientific portion of the public nowadays is getting pretty well used to the idea of species as an uncertain quantity. One reads in the catalogs of seedmen and landscape gardeners of all sorts of hybrid plants that come true from seed and are greatly superior to the old pure strains. One learns of whole herds of cow-buffalo hybrids that are fruitful and multiplying. One reads of Indian cattle imported by the Department of Agriculture to confer immunities on our own domestic species. There are a great many more farmers in the United States than of any other sort of person; and farmers are becoming scientific. Of necessity, then, Linné's idea of species, which was quite wrong, tends to evaporate from minds that in general are thoroughly Biblical and Creationist.

Linné, surrendering species as the created unit, could fall back on the genus—one original lion-tiger-housecat; one original dog-wolf-fox. Linné could do that, because in Linné's time there was no paleontology. Now we know that the fossil creatures of the lower Tertiary close so many gaps of the order of dog to cat, horse to cow, elephant to trunkless mammal, that there is no stopping with the genera. All this, moreover, is in the schoolbooks. If the parents do not know, the children soon see that they learn.

In other words, there are only two courses open to the present-day Creationist. He can shut his eyes to the evidence, insist that "after its kind" means Linnæan species and nothing else, and maintain a traditional opinion as a matter of dogma. On the other hand, he can open his eyes, see what has probably occurred, and read his Biblical texts in the light of that.

This last, various believers in Special Creation now appear inclined to do. First they give up species and try to stick at genera. Then they surrender the genus and try to stick at the family, which is a group of related genera. The big tailless apes are one family; we men are another. That far several present-day Creationists appear already to have gone. But, obviously, the process once begun, nobody can stop for long short of the order—all the bats, all the whales, all the hoofed quadrupeds, all the carnivors. If one were willing to take still another step and should maintain that man is one independent creation, that the higher mammals are another and the non-placental mammals still a third, the birds one or two or three more, with reptiles, amphibia, and fishes making at least three besides, let us say a hundred or two for the entire animal kingdom, he probably could not be dislodged by argument on the facts. The opinion is not the straightforward inference from the evidence. But given the evidence as known thus far, it probably could not be disproved. If one should go one step farther still and make the created unit the grand divisions of the animal and vegetable kingdoms—the vertebrates, molluscs, arthropods, echinoderms, and the rest, with the equivalent divisions of the plants—one would have to suppose some thirty or forty special creations only, and would sidestep pretty much all the objection that can be brought against any Creation Theory from the side of science. To something of this sort, Creationism already shows signs of having to come.

Oddly enough, one who should take this ground would find himself very much of Darwin's opinion. The view that all animals and all plants are evolved from one primitive "amœba-like" creature, neither animal nor plant, which in turn arose spontaneously out of inorganic matter like the creatures out of the Nile mud in the Ten Plagues of Egypt, is more Haeckel's idea than Darwin's. It rests on logic. It does not rest on much direct evidence. That is why Darwin was shy of all such notions.

Darwin's own words, at the end of the final chapter of the *Origin*, where he hoped, vainly it has proved, that they would sometimes be read, summing up his whole case, are these:

"To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes, like those determining the birth and death of the individual . . . There is a grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms, or one; and that . . . from so simple a beginning endless forms most beautiful and most wonderful have been and are being evolved."

Toward this view of Darwin's, creationist opinion seems just now somewhat to be tending. How far it will move and where stop is on the knees of the gods.

Oddly enough, however, along with this somewhat vague tendency to make larger and larger groups of organisms the original units of creation, there goes also, just now, in theological circles, another trend, still more vague, in precisely the opposite direction.

The group of somewhat independent notions which nowadays we lump together as "Mendelism,"—and which, roughly, may be taken to date from the appearance of Bateson's *Materials for the Study of Variation* in 1894,—has turned scientific interest decidedly away from Linnæan species, to quite another set of elements, smaller even than the individual, the "unit characters" of current Mendelian theories of inheritance and of our current doctrine of discontinuous "mutation" among both animals and plants.

Why, then, have asked lately certain theologians, may it not be, that neither the Linnæan species nor any larger group than this, is the real unit of the Creator's direct activity? May it not be that, after all, the act of creation really consists in originating those much less conspicuous but vastly more numerous new creatures, the "mutants" or the "elementary species" of current genetics, on which rest much of the present-day theory and practice of breeding domesticated animals and plants? There again is a theological doctrine of creation that probably can not be attacked on scientific grounds. There again is a notion too incoherent to be within the range of detailed examination. This also is still on the knees of the gods.

There is, moreover, still a third tendency of contemporary opinion, that is neither theological nor scientific, but philosophical.

I have called Louis Agassiz the Last of the Creationists. That, however, is only in the narrower senses of all the terms involved, where the line between creation and evolution turns on the single point, the origin of species—the sense, let us say, which the words, as words, have had for the last century and a half.

But always, quite outside all scientific theory, there still remains that immemorial problem of philosophy, the relation between "thoughts" and "things." This ancient problem has been attacked brilliantly of late—as witness, along with other works, the *Creative Evolution* of Monsieur Henri Bergson. Speaking broadly, present-day philosophizing tends to ignore distinction between creation and evolution, to view both as but two aspects of one reality, in a very real sense to get behind all the controversies of the last half of the eighteenth century and the first half of the nineteenth, and in short, just now and most wholesomely, to go back, albeit under modern guise, to the ideas of Augustine and Aristotle.

All this, however, important as it is, lies equally outside the proper field of a history of a scientific theory and the competence of an historian to discuss. Theology and philosophy are not science. As a scientific theory that accounts for any known detail of any animal or plant, living or fossil, "the coming of age of the *Origin of Species*" in 1880 closed another chapter in the history of opinion. Thereafter, for all branches of natural science, the origin of anything now known by any sort of "creation" "in the beginning" has gone the way of the Ptolemaic astronomy, the four-element chemistry, magic, and a flat earth.

Certain things are known to have evolved. About them, back of that, Science nowadays knows nothing.

THE END

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BIBLIOGRAPHY

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